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PENDING LEGISLATION FOR FEDERAL AID TO SCIENCE

ON November 14, 1945, a number of persons met at the call of President Isaiah Bowman, of the Johns Hopkins University, to discuss pending legislation for federal aid to science, particularly as represented in the two bills proposed respectively by Senator Magnuson (S. 1285) and Senator Kilgore (S. 1297). Both bills propose a national research or science foundation for federal aid to science, but the two bills start from wholly different premises with respect to the purpose of such a foundation and therefore they present widely divergent points of view and completely different organizations. Senator Magnuson's bill is based upon Dr. Vannevar Bush's report to President Truman, entitled "Science, the Endless Frontier."

Those present at the above meeting moved to bring into existence a *Committee Supporting the Bush Report,* one purpose of this committee being to restate the fundamental principles emphasized in Dr. Bush's report, since it is believed that observance of these principles is of paramount importance to the whole future of scientific research. It has seemed appropriate to make this statement in an open letter signed by members of the committee and addressed to President Truman. A copy of this letter follows:

The President of the United States,
The White House,
Washington, D. C.

DEAR MR. PRESIDENT:

We, the undersigned members of the newly organized Committee Supporting the Bush Report, respectfully address you on the subject of pending science legislation, as follows:

Subsequent to the publication of the Bush Report, "Science, the Endless Frontier" (July 19), you stated to the Congress that you were in favor of federal support for scientific research, fellowships and scholarships. Bills designed to provide such support have been introduced by Senators Kilgore and Magnuson. Most of the scientists called to testify at hearings on these bills stated that they were in favor of the form of organization and other features provided in the Magnuson Bill. We understand that in your name certain government

officials have recently disapproved the plan favored by the scientists.

For the reasons stated in the Bush Report, we are in favor of federal support for scientific research and education. We are in favor of the Magnuson Bill, which was designed to implement the plan outlined by Dr. Bush and approved by his advisory committees. We are opposed to the Kilgore Bill.

We take this means of bringing our views to your attention, of stating the principles on which we think sound legislation must be established, and of bespeaking your further, favorable consideration of the Bush-Magnuson plan which the scientists desire and will support.

1. Our experience leads us to believe that responsibility for the program should be placed in the hands of a national science or research board composed of laymen and scientists appointed by the President without reference to political affiliation and solely on the basis of interest in and capacity to promote scientific research and education. Nothing should preclude the President from appointing any qualified person, scientist or layman, but in making appointments it would be desirable to seek the advice of scientists and scientific organizations. Ordinarily board members should be persons having no other official connection with government. The board should be made up of persons who would regard appointment as an opportunity to perform a national service of the highest importance and in whom the scientists called on to give professional and other assistance would have confidence. These principles are fully recognized in the Magnuson Bill.

2. In our opinion it would be most unwise to subordinate the board to a single director appointed by the President, as is done in the Kilgore Bill. No single person, however eminent or competent, could, except in a great emergency, command the confidence and support of all branches of science and of the many organizations and agencies, private and public, whose cooperation will be required. This is an adventure in government for which there is no peacetime precedent; there will be risks and difficulties and responsibilities far beyond the capacity of any individual. A subordinated board—a board without ultimate responsibility—would be, or would tend to become, a weak board, especially if it consists in part of *ex-officio* members, that is, members employed by, and therefore responsible to, other agencies of government. We favor a responsible board as provided in the Magnuson Bill.

3. The board should be responsible for the appointment and supervision of the chief administrative officer, who should look after internal affairs, as provided in the Magnuson Bill. The administrator should not be in a position to dictate or interfere with the activities either of the board itself or of the professional committees appointed by the board; he should be the agent—not the master—of the board.

4. We are strongly in favor of the distribution of professional responsibility among divisions or committees made up of professional scientists selected by a responsible board on recommendation of the National Academy of Sciences and other qualified organizations, as specified in the Magnuson Bill.

5. There should be no mandatory provision for *ex-officio* members. The board itself and the professional committees should establish and maintain close and effective relations with all scientific agencies within the government; representatives of other government scientific agencies should be encouraged, and perhaps required, to consult and advise, but should not be empowered to vote. *Ex-officio* professional committees, like an *ex-officio* board, would not be designed to formulate and carry out a well-considered, imaginative program; they would tend to encourage or permit the promotion of special interests and log-rolling. The Magnuson Bill is designed to avoid these evils.

6. While the board should know about and influence the scientific programs of the Army, Navy and other departments, we think that it should not undertake to control or coordinate all government scientific activities to the extent and in the manner required by the Kilgore Bill. Indeed, we think that—given high standards and sound practice in scientific education and research—proliferation of interests and activity, together with a high degree of institutional and individual freedom and responsibility, is desirable.

7. The legislation should not attempt to settle the government's patent policy. The subject of patent reform, formerly assigned to the National Patent Planning Commission, has now been placed by you in the hands of a committee headed by the Secretary of Commerce. We think that for the present it should be left in those hands —that partial solution of this important, complex problem should not be anticipated, as attempted by the Kilgore Bill, in legislation providing for a national research or science foundation.

8. In your recent message you stated that the social sciences, as well as the basic sciences, should receive support from the proposed national science or research foundation. With all respect, we think it would be a serious mistake to include the social sciences (sociology, political science, economics, law, etc.) at this time. In saying this we do not wish to be understood as suggesting that no such provision should be made for social studies. Rather we wish to emphasize that we do not believe that the group which will administer grants for research, scholarships, and fellowships in the basic sciences would be the appropriate group to allocate funds to the social sciences, or that they will be in a position to interpret the will of the Congress as to the proportion of the funds to be used among the many social sciences. We believe that the social sciences should be taken care of by a separate body. The Bush Report was based upon factual studies showing the need and outlining a program for federal support in the basic sciences; there are no comparable data and programs for the social sciences. Looking only at the scholarship and fellowship program, it is believed that the board proposed in the Bush Report and provided for in the Magnuson Bill could do an excellent job in the selection and support of scientific students; it would be faced with a very different sort of task—a task for which it would not be qualified—if it were required to make simi-

lar provision for students of sociology, political science, economics, law, etc. Our reasons for excluding the social sciences from this legislation apply with even greater force to the type of administration required by the Kilgore Bill.

To summarize: We are in favor of a responsible board composed of laymen and scientists appointed by the President on the basis of interest and capacity, with a full time administrator appointed by and responsible to the board. We are opposed to mandatory provision for *ex-officio* members either of the board or of the professional divisions. The board should not be empowered to control or coordinate other government scientific agencies, although effective liaison should be established and maintained. This legislation should contain no provision respecting patents or the social sciences.

In conclusion, Mr. President, the great majority of American scientists are in favor of federal aid to scientific research and education, and we are confident that, if legislation based on the principles stated above be enacted, the program sponsored by Dr. Bush and the many scientists and others associated with him can be made a great success. We hope that on further consideration you will support the Bush Report and the Magnuson Bill.

Respectfully yours,

NOVEMBER 24, 1945

ISAIAH BOWMAN, *Chairman of the Committee; President, The Johns Hopkins University*

ROGER ADAMS, *Professor of Organic Chemistry, University of Illinois*

CARL D. ANDERSON, *Nobel Laureate; Professor of Physics, California Institute of Technology*

BORIS A. BAKHMETEFF, *Professor of Civil Engineering, Columbia University; Chairman, Engineering Panel appointed by the Engineers Joint Council*

G. W. BEADLE, *Professor of Biology, Stanford University*

D. W. BRONK, *Director, Johnson Research Foundation*

GEORGE GRANGER BROWN, *Past-President, American Institute of Chemical Engineers*

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WARREN WEAVER, *Director, The Natural Sciences, Rockefeller Foundation*
BETHUEL M. WEBSTER, *Webster and Garside, New York*
LEWIS H. WEED, *Director of the School of Medicine, The Johns Hopkins University; Chairman, Division of Medical Sciences, National Research Council*
F. C. WHITMORE, *Past-President, American Chemical Society*
ROBERT E. WILSON, *Chairman of Board, Standard Oil Company of Indiana*

On behalf of the combined executive committees of the Union of American Biological Societies, comprising 38 national societies, and of the American Biological Society, dealing with cooperative functions of biologists; we heartily endorse the viewpoint, expressed by the Committee called by President Bowman, as supporting the Bush Report of which the principles are being incorporated in an impending bill, sponsored by Senator Magnuson.

In the formation of the National Science or Research Foundation, the three main proposals are: first, that the responsibility be in the hands of a board composed of laymen and scientists to be appointed by President Truman solely on the basis of interest in promoting scientific research and education; second, that no *ex-officio* members from other Government agencies serve as active members on the board, and third, that the board be responsible for the appointment of the chief administrative officer of the foundation.

As biologists we are also keenly interested in having realized the contemplated plans to include the biological sciences in a division of basic science separate from medical research and public welfare.

ROBERT CHAMBERS, *President, Union of American Biological Societies*
J. S. NICHOLAS, *President, American Biological Society*

NOVEMBER 24, 1945

ORGANIZATION AND SUPPORT OF SCIENCE IN THE UNITED STATES[1]

By Dr. L. C. DUNN

PROFESSOR OF ZOOLOGY, FACULTY OF PURE SCIENCE, COLUMBIA UNIVERSITY; CHAIRMAN, AMERICAN-SOVIET SCIENCE SOCIETY, NATIONAL COUNCIL OF AMERICAN SOVIET FRIENDSHIP

THE war and the sudden need to improve means for supporting and directing war research have brought into high relief an important fact which has been dimly recognized for many years: there has been in the United States no orderly means for the continuous support of fundamental scientific research, and no policy or method for the deliberate utilization of science by our society. Science has been a hardy plant which grew where and how it could, thriving in the comfortable greenhouse of a research institute, or turning ample fertilizer into real fruit in an industrial laboratory, or in the more usual case struggling for sustenance in the thin soil of colleges and universities, occasionally enriched by temporary growth stimulants from a foundation or private donor. Except in the case of certain industrial developments and in a few government departments, the support of science in the United States has not been the result of decision but of chance, operating in a milieu which contained good scientists and a good deal of fluid wealth.

The most blunt and truthful statement we can make about the reason for the lack of continuity and of public policy regarding science is that, as Americans, we did not want either continuous support or direction or planned application of science. The detailed causes of this attitude trace in part to reasoned premises and in part to prejudice; and from these there has resulted a confusion of thought which the war has now revealed.

The contradictions come out most clearly in the views of scientists concerning the support of science after the war. Most of them hope for release from the capricious and precarious methods by which fundamental research was chiefly supported before the war, namely, by periodic begging from donors, such as foundations who chose the researches to be supported. Scientists generally hope for a more orderly and stable means of support than this, yet most of them would not turn to the Federal Government as the source of more continuous support. They profess to fear infringements on their freedom more when support comes from their government than when it comes from private sources.

There is no sense in dodging or belittling the dilemma in which this places science. On the one hand, the war agencies which have guided and financed a large segment of scientific research propose to withdraw from this function. If they do, the public investment in scientific research will drop to

[1] An address given on May 3, 1945, before the chapter of the Society of Sigma Xi of the University of Rochester. This address will form one chapter in a forthcoming book "Currents in Biochemistry" Edited by Dr. David Greene, to be published by Interscience Publishers, Inc.

a third or a quarter of its present level. At the same time, the principal sums in the hands of the great foundations are declining and science must adjust itself to diminishing support from this and other private sources, and possibly to the extinction of this sort of financial aid within another generation. There will eventually remain as sources of support chiefly industry and business, through their research laboratories and foundations, and the government, through its own scientific agencies or through new channels yet to be created.

Most scientists who do not like "domination of science by government" like "domination of science by industry" even less; and many have already objected to the influence which the foundations wield because of their control of the fluid funds with which to supplement the fixed investments of universities and research institutes in men and permanent plant. It has often seemed that this small tail of free funds has wagged the larger dog of solid investment.

Moreover, scientific research depends upon trained men and women as much as upon material facilities, and we have as yet made no provision for assuring a steady flow of young scientists into research. For advanced training we have relied upon the existing scholarships and fellowships of the universities, which are so meager that most young scientists can devote only a portion of their time to learning, the rest being needed for earning a living; and upon the advanced fellowships supplied by foundations, private philanthropy and industry. The same considerations of approaching exhaustion of private funds apply to the training of persons as to the provision of research funds.

The facts that must be faced are, then, that the present means of support of science are running out and, whether we like it or not, changes in the sources and form of support will occur; and that a chief desideratum for scientists will be to keep science under the new conditions as free as possible to develop according to its own inner needs and according to its function in society.

In the following pages I propose to discuss, first, what the function of science is that entitles it to support; second, what determines the attitudes of scientists toward forms of support; third, what general public policy toward science would represent the best interests of science and scientists; and, fourth, how this policy could be implemented in practical ways.

At the bottom of every consideration of science in its public aspects must lie the question: "What is science for?" When this question is squarely and thoughtfully faced, scientists will agree that science exists for man and not for itself alone. As a means of understanding the material world, it leads toward the improvement and control of the environment in which human society must always operate. Eventually, its results and the methods of thought which it develops accrue to the public good, not merely by increasing the physical well-being of the people through technological applications, but also by extending the domain of reason and by increasing our understanding and appreciation of nature. In discussing the material means which have to be provided for scientific research, it is often forgotten that the great and lasting changes wrought by science are in men's minds, and that, in the end, science is to be supported for the same reason that education is to be supported. The products of science are primarily increase and diffusion of knowledge and increase in the number of trained minds, and secondarily increase of technical facilities and production of goods. Like other knowledge, scientific understanding is one of the "rights" to which all citizens should have equal access. Its support, like that of education generally, is thus to be shared, as most essential activities are in our society, by the State and by "public spirit" as it acts through foundations, private citizens and industry. At the material level, science in the modern world has become a public necessity without which technical advances and social developments determined by them can not occur in an orderly way. It has become so "affected with the public interest" that its support must be a matter of public concern. The scientist has thus become in some sense and in spite of himself a public servant.

Those many scientists who are serving their country in the war as scientists are less likely now than formerly to forget their public function; but in the past a failure to recognize this led scientists as a class to have too little confidence in seeking support for scientific work. They were not sure that science was worthy of public support, because oftentimes science was not what the world needed, but only what they enjoyed doing. They did not generally think about a public policy for science because they were not clear about the public function of science. Can we really expect (they would say) the public to support this kind of work? Or as a small boy said to a scientist after a visit to his research laboratory, "Uncle, do they really pay you for doing this?"

When questions about the organization and support of science were raised, however, other reasons were generally given for either opposing the formulation of policy or avoiding the question altogether. These reasons took different forms, but in general had their roots in our tradition of individualism. Since scientists have usually been strong individualists, the traditional public objections to schemes for the support and direction of science have been strengthened and

rationalized by the scientists themselves. They said: "Organization kills initiative"; "Planning interferes with free enterprise," or "Continuously assured support removes the need for periodic justification of each research on its own merits." "Support implies direction, and he who pays the fiddler will call the tune; and only scientists can know what tunes can or should be played."

These are valid and weighty objections and they must be squarely met by any general proposal for the maintenance or direction of science. It is nevertheless true that these are not the primary or real reasons for opposing the formulation of a public policy or even specifically for opposing the support of science from public funds, since the same scientists who use them against government support approve the use of organization, planning, continuous support and central direction when these are employed, as a matter of policy, in the great industrial laboratories. In fact, many scientists point with pride to the splendid results which industrial laboratories have achieved under the very conditions which they allege would impede and stifle scientific research done at the expense of government. Moreover, public support and direction appear to have been quite acceptable in the great program of agricultural research which has been in operation since 1887 through the United States Department of Agriculture and the State Agricultural Experiment Stations. These facts are not cited to minimize the difficulties involved in planned continuous support and direction of research. They do show clearly, however, that the objections are generally not to support and direction as such but to these only when the authority which wields them is the Federal Government. As the attitude toward agricultural research shows, the objection does not apply with similar force to the State governments. Many scientists have expressed the fear that central and especially federal support of scientific research would put an end to "scientific freedom" and lead to "regimentation." In most cases, it is the threat to scientific individualism or "free enterprise in science" that is the real cause of fear. Since such changes in modern society as the decline of individualism are not due to deliberate acts of governments but result from the social and economic and technical developments of our age, they call, not for fear, but for a greater effort to understand them.

I believe that most scientists have come to realize the nature of such objections to discussing general policies for the public support of science. The central position that "pure science," especially physics, came to occupy in war research revealed facts about science in the modern world which simply could not be evaded or overlooked. Even the need of "coordination," the blackest of the beasts which threaten the research scientist, became evident as soon as the war imposed pressing requirements which an unplanned, uncoordinated science could not meet. The knowledge that our enemies had succeeded in so organizing their research and development programs that they had "got the jump" on us in numerous ways persuaded even reluctant individualists that coordination was absolutely necessary.

The war emergency also revealed the lack of balance which obtains when science is directed by chance. Many fundamental problems, upon which other inquiries depended, had not been touched and efforts had suddenly to be made to straighten the front. If this was borne in upon those scientists who participated in war research, it became even clearer to those who through lack of organization were left out. There are now many biologists who would sacrifice their cherished individualism for the sake of being identified with a great national effort. They realize that the neglect, the omission almost, of biology and biologists from the hastily improvised war agencies was bad not only for biology and for other sciences, such as the medical and agricultural sciences which depend upon biology, but for the nation. Their state of mind is not improved by the reflection that, by and large, the fault was their own.

Still other changes in the attitudes of scientists are due to the growing realization that research workers need to recognize the connection between their own special work and the general scientific structure in which it will find its place and its function. It is difficult for the research worker to envisage this larger field without inquiring too about the still wider frame of society in which science operates. Many more scientists than formerly now believe not only that this social awareness of the men who do the work of science is needed to make a social being and a citizen of the scientist, but that this is essential in the national interest. Those who so believe will want to face the questions involved in the public support of science.

By these paths we come to the problem itself: what public policy toward science would encourage the best growth of science and its use for the welfare of the people? The aims of policy must be to reconcile two basic requirements, about which there is probably general agreement.

(1) Science and scientists must be free to grow and change in ways determined in part by the discoveries of science itself. This is the way in which science has progressed in the past—and the autonomy of small groups and the feeling of freedom of the individual to follow the new idea wherever it may lead are goods which must be preserved. This freedom must be accepted and guarded as a matter of principle; and pro-

visions for freedom of publication and the prevention of arbitrary censorship must be a part of the basic policy.

(2) The forms of support and organization of science must be determined by social needs and purposes and are therefore matters of concern not only to scientists but to government and to the ultimate beneficiaries of science, that is, the people, as consumers and workers. Those who most directly need and use the results of scientific research in education, industry, agriculture, medicine, and public health have a special interest in the development of science, and means must be provided by which this influence can be exercised. The two primary conditions should therefore be: (a) a central organization by which the conduct of science is made responsive to public requirements and needs; and (b) the representative character of the directing agency or agencies, insuring democratic methods of administration.

These two requirements of autonomy, on the one hand, and subservience to social needs, on the other, have seemed antithetic to some, but I do not believe this need be the case. There is much evidence of the vitality and progressiveness of science in other countries where it is largely under public control. The extreme example of public control is in the Soviet Union, where the direction of scientific research is centralized in the Academy of Sciences, through which the support of the state flows to all of the research agencies. Other European countries occupy positions intermediate between this maximum and the minimum reached in the United States, where almost alone among modern nations science has retained a predominantly private character. Even here, the wartime activities of the Office of Scientific Research and Development and the Committee for Medical Research show that no essential incompatibility exists between research and public control; while the long peacetime history of United States Government scientific departments and especially of the Department of Agriculture illustrate the feasibility of accomplishing at once a scientific and a social purpose.

Much experience in the United States and in other countries indicates that, to obtain the maximum results from a given effort in scientific research, the interests of the research workers themselves must be consulted, but that these are not fundamentally different from those of the community around them. Scientists traditionally are primarily devoted to their work, often sacrificing other interests to it and excluding other interests which tend to interfere with it. Yet, as the war shows, they will voluntarily and gladly place this devotion and their technical ability and intelligence at the service of an objective which is clearly defined and compelling. On the other hand, directing agencies, public or private, do not grudge to the scientist a greater measure of freedom than to other workers, provided they are assured of his adherence to the principles of service and to the general purpose which they consider essential, and that this freedom actually produces the results expected from it. Freedom within a general plan is a practical ideal at which to aim, as the comparative freedom of local political units within the general frame of Federal Union of the United States shows.

Voluntary cooperation of scientists with public agencies in the planning and execution of research would seem to provide the soundest base. The greater tendency toward teamwork and pooling of ideas by groups of scientists, the distribution of responsibility and credit for scientific work among the whole staff of a laboratory, the greater diffusion among younger scientists of the sense of social responsibility and the resulting tendency for social incentives to supplement more purely personal motives—these facts all indicate that it is reasonable to expect that scientists can and will participate in formulating the plans they will execute. This leads to the kind of self-government to which democratic administration tends, and which industry has found valuable as an incentive.

A further question that policy must meet is the ultimate disposition of the new knowledge which accrues from science. In the large segment of scientific research under private control, it is generally agreed that the ownership of valuable processes arising from research is to be vested, not in the individual scientist, but in the laboratory or the industry which has financed the research. Patents therefore generally become the property of the corporation by which the scientist is employed.

The question of ownership has already arisen concerning values accruing from war research, and it must enter inevitably into all plans for the future support of science.

The clearest basis for policy in this regard is that research done for a social or public purpose must be brought as quickly as possible to serve this purpose. If it is carried out for the public and at public expense, it should belong to the public; and there is no more direct way of making it public property than by publishing it as soon as the facts are clear. Publication would preclude patenting and, with certain precautions to be discussed below, would prevent the results of public science from becoming private property. But, by the same token, the results of private science would remain private, subject to patent or other ownership rights and restrictions.

A division of this sort already exists. Most agricultural research in the United States is done at public expense and results are freely published and can

be consulted and used by anyone. The greatest change in American agriculture in the present century, the introduction of crossbred or hybrid corn, resulted chiefly from cooperative research between the United States Department of Agriculture and the State Agricultural Experiment Stations. The results were quickly utilized by private seed companies, none of which was able to obtain a patent or found a monopoly on it. Crossbred corn therefore came very quickly into general use and its benefits were soon spread over all agricultural communities.

Side by side with this development, it was possible for private individuals and corporations to produce and patent new varieties of other plants, such as roses, which could be propagated asexually. The ownership of new rose varieties is thus (in general) private; but the new method of corn breeding belongs to the public.

The question of property rights need then be faced only when new values are created by publicly supported research; and the basic policy stated above—that is, free publication of the results of public research—need not interfere with existing arrangements under which private research operates. As a matter of fact, the more fundamental the research in the sense that the more general the truth that arises from it, the less will property questions arise. It is hard to find a patentable value in the general theory of relativity, or in the periodic system of the elements, or in the theory of the gene. It is the fate and the function of such ideas to become common property, and no man-made rules should be allowed to interfere with their free circulation. It is usually only the specific applications of general ideas which become subject to property restriction; and public policy can only aim at preventing such restriction from interfering with the advance of science or with the spread of the benefits to the people.

It is time now to deal briefly and in bare outline with the last question: how can these ideas and hopes about the support of science be brought into practical operation?

It seems evident that there must be an agency having as its chief concern the preservation, advancement and diffusion of scientific knowledge. There are, in the United States, dozens of organizations having this aim in limited spheres, but that not one of them fulfilled the required functions in the national interest became evident when, in the war emergency, a wholly new and temporary agency, the Office of Scientific Research and Development, had to be created. The importance of the work assigned to this office, and the powers and facilities which accompanied the responsibility, pointed not only to the need but to the method of meeting the need for a central agency of government concerned with science.

It is probable that nothing less than the creation of a cabinet department of science under a Secretary of Science can permanently meet the need. It ought to be connected directly with the central executive body of the government, because only in such a position can it be made aware of the basic problems which face the nation, and only through the political power which attaches to cabinet rank can it gain the means and facilities with which to support the study of both immediate and long-term problems.

The structure of such a department may well be different from that of other government departments because, in addition to policy making and administrative functions, it would have to serve as a coordinating agency for many existing scientific agencies, both public and private. To name only two groups of interests, it would have to be closely connected with the universities and research institutes, and with industry, since in each of these institutions needs for new knowledge are likely first to become apparent, and from each flows scientific and technical information which can be put to use in national defense and development.

At the heart of such a department could well be a board or council of scientific research which could act at once as a granting agency, allocating funds for specific researches, and as a board of strategy, seeking out neglected areas, mobilizing disparate facts and distant persons, and shifting its forces from time to time to explore new avenues of research. If it fulfilled its best purpose, it could not be content to sit and sift, but would itself have to search and ponder in a more active way. Its basis of operation as a granting agency might well be patterned upon the Office of Scientific Research and Development in that it might receive applications for research funds from universities, research laboratories, other government agencies, or even individuals, and might enter into contracts with those it judged as offering the best prospects for needed scientific advance. Like O. S. R. D., it might find no need to become an operating agency with plants and facilities of its own, although it should have some freedom to use those methods best calculated to promote the best research.

Much would depend upon the composition of this board. It should consist of working scientists who can judge the merits of various research proposals and policies, and of representatives of those for whose benefit the research is done and who in the end pay the bills, that is, the public as represented by labor, consumers and industry, small or large. Perhaps a proportion of eight scientists and four public representatives would express both the purposes and responsibilities of the board; and some of the scientists

should be drawn from, or be primarily interested in the scientific work of, the government departments.

Since there should be no disposition on the part of such a board to displace any existing research agencies, but rather to supplement and aid them, its most important function might well turn out to be, especially in its initial operations, that of coordinating and facilitating research generally. It would undoubtedly avoid competition with industrial research, and direct its first attention to "unprofitable" fields such as exploration looking toward new natural resources, housing, public health, etc. It would probably be concerned with such public services as the provision of adequate means of publication, of bibliographic and library services, of abstracts and translations of foreign scientific literature and similar functions.

Either this board or another one in the Department of Science would of necessity concern itself with one of the basic questions in all scientific research: how to insure an adequate supply of trained scientists for research, for education, for industry and for public service. Its operation in this respect could well be patterned upon the fellowship boards of the National Research Council, which at present administers limited and temporary funds supplied from private sources.

Two main criticisms to the proposal outlined above may be anticipated. One is that research can not be free under a central direction, but will wither and die. Scientists, it is said, will not submit to regimentation, nor can new ideas, the life blood of science, be created by subsidy. The other criticism is that the needs are already met by such existing agencies as the National Academy of Sciences and the National Research Council.

The first criticism is certainly a cogent one when central control is proposed, but it applies with less force to a board which judges applications initiated by working scientists as individuals or groups, especially when many of the judges are themselves working scientists who know how delicate a plant original research is and how necessary is the atmosphere of freedom to its growth.

Much will depend upon the degree to which members of the board realize that any organization of this sort exists primarily to provide a material body for the mind of science. There are scientists and others who know this and who apply to organizations proposed for science two essential criteria: Does it provide the mind with adequate and proper facilities? Does it leave the mind free to strike out in new directions? Men who ask these questions are the ones whose sense of public duty would bring them into the service of such a board, just as it brought such men into the direction of war research.

In regard to the second criticism, it must be pointed out that in the war emergency neither the National Research Council nor the National Academy of Sciences proved to have the character needed for an agency to guide and administer the organization and support of science. Neither is an operating agency; and, as constituted at present, neither could provide the initiative and the administrative services which are required. The relative isolation in which they have functioned has removed them from that close connection with problems of public policy so essential for an agency to have which is to be responsive to public needs. They have the confidence of scientists and close connection with academic research and with the scientific societies and organizations and are thus well prepared to serve an important advisory function. The National Academy of Sciences, as a council of elder statesmen, could well be called upon to pass upon the qualifications of scientists proposed for membership in the Board of Scientific Research. The academy would be less able to maintain sufficiently close relations with consumers, with labor, and with industry, and it would be less competent to advise on questions bearing on the social relations of science in these fields.

The board might conduct its relations with the scientific societies through the National Research Council, which could then be incorporated into the Department of Science and carry out other important functions, such as maintaining a permanent roster of scientific personnel.

It is of course possible that the academy and the present National Research Council might be so changed as to assume the functions it is proposed to assign to the board. The changes would be so fundamental as to constitute conversion of these older organizations into a new department of the government; and it is probable that the traditions of both institutions would make such conversion a slow and difficult process, for, in spite of their "national" character, neither has felt itself to be a truly public agency.

In this brief sketch, it has not been possible to indicate what the relations of the new organization would be to existing scientific departments and bureaus of the government. Some, like the Bureau of Standards, would probably become a part of the new department; others, like the Department of Agriculture, are already so important as to require separate existence and budgetary independence, although certain of their research functions could well be assumed by the new department. But these and many other questions will require thorough study and discussion both by scientists and statesmen.

Finally, as scientists, we may ask what practical steps we could take to hasten the consideration of

questions about the organization and support of science. One suggestion arises directly from the fact that, as scientists, we have no over-all organization to bring our views on such questions to a focus or to represent our interest in public matters, or to permit our influence to be brought to bear upon problems which affect the scientist. Perhaps we should have a guild or a federation of scientific societies which could concern itself with such questions.

As scientists, we might also encourage and cooperate with those statesmen who have seen the need and have begun to study the problem of the public support of science. Too frequently we have remained aloof or have opposed even the public discussion of the problem. Apparently we have still to learn that there is a politics concerned with policy, and that only through such a political channel can science come to occupy its rightful and necessary place in the state.

OBITUARY

HERBERT EUGENE WALTER

PROFESSOR WALTER died at his home in Providence, Rhode Island, on October first, in the seventy-ninth year of his age. He was born on a farm in Burke, Vermont, on April 19, 1867. Living as a schoolboy in the neighboring village of Lyndon Center and marrying Alice Hall of Lyndon in 1893, he always remained a staunch Vermonter, returning there for frequent summer visits. Mrs. Walter, who is an ardent ornithologist, survives him. Over the course of many years their keen mutual interest in birds served them as a semiprofessional pastime, resulting in the collection of many records and in substantially furthering the cause of wildlife conservation.

Walter graduated from Bates College in 1892, and in 1939 he received the honorary degree of Sc.D. from his *alma mater*. A similar honor, also the Sc.D. degree, was conferred on him by Middlebury College in 1934.

His graduate work began at Brown University in 1892–93 under the tutelage of H. C. Bumpus, at that time professor of comparative anatomy. Their early association, already begun during several summers at Woods Hole, led him to Brown and proved to be the beginning of a lifelong friendship. The next year was spent in Germany, following the habit that then prevailed among young aspirants to a zoological career. He was very fortunate to proceed to Freiburg, where the quartet of Heeren Professoren at the Anatomisches Institut included the justly celebrated Weismann and Wiedersheim.

Walter was a delightful writer, and his Germanic experiences at Freiburg are interestingly set forth in a brochure entitled "One Innocent Abroad," published only very recently (1943) and circulated among a wide circle of his friends.

On his return from Europe he took a position as teacher of biology in the North Division High School in Chicago, where the writer and his boyhood friend, A. L. Melander, had the great good fortune to receive their first instruction in the mysteries of biological science at his hands. Then, as later, Walter was a marvelously fine and enthusiastic teacher whose equal I have seldom known. He took a great interest in secondary education during this period of ten years, but wanted to return east and complete the graduate study he had begun in Germany.

The two following years were spent at Harvard University, where he received the degree of Ph.D. in 1906. At this time he relinquished temporarily his primary interest in vertebrate zoology and presented a doctoral dissertation dealing with the behavior of planarians, a study sponsored by Professor G. H. Parker. W. E. Castle, another member of the Harvard biological faculty, was already at work in the newly born science of genetics and Walter's interest in this phase of biology was aroused, later to be further stimulated by association with C. B. Davenport, another pioneer geneticist.

Following the interlude at Harvard, Walter joined the faculty of Brown University, of which he remained a member for thirty-one years, first as assistant professor, then as associate professor and finally for fifteen years as professor of biology. He retired from active teaching in 1937.

Concurrently with his activities at Brown, from 1906–1927 Walter spent a considerable part of each summer at the Cold Spring Harbor Biological Laboratory, where he conducted a class in field zoology. The daily meetings of this class, in which the writer had the opportunity to take part on several occasions, were a round of continued activity on the part of all participants. There were frequent trips to selected marine, fresh-water or terrestrial habitats, where the fauna suffered an inquisition that offered an opportunity to acquaint the members of the class with a most varied list of animals, numerous plants, and furnished the cue to present many biological principles in vivid form. At the end of each session a daily report was prepared on a simple mimeograph held in readiness at the laboratory. These reports, often embellished with appropriate diagrams, Walter prepared, printed and distributed with the precision and well-ordered haste usually associated with the afternoon edition of a metropolitan daily. This class is selected as an example of the unusual facility with

which he was able to inject enthusiasm as well as to implant information in the minds of the many students who came under his care.

During these summer sessions at Cold Spring Harbor Walter was closely associated with C. B. Davenport, the director of the laboratory, and his continued interest in genetics was fostered by this relationship. From 1917–1927 Walter served as assistant director.

His college lectures were always entertainingly presented, aided by his ability to draw with notable skill on the blackboard. His diagrams, together with gadgets that he devised and perfected, aided particularly in demonstrating the mechanism of inheritance. His greatest interest was in the comparative anatomy of the vertebrates, and this occupied a major part of the time he devoted to teaching.

Walter published a number of books and papers on various zoological subjects, but his most important contribution is embodied in two of the books. The first of these, "Genetics," was published originally in 1913, revised in 1920, and finally rewritten in 1930. His versatility in presenting difficult matter for student consumption is best illustrated in this text. The other, "Biology of the Vertebrates," dealing with his favorite group of animals, diverges considerably from the usual text-book style of presentation, but its interest and instructional value are greatly enhanced thereby. This book appeared first in 1927 and after a dozen reprintings was issued in revised form in 1939. Only a week before his death he had cheerfully planned a further revision requested by the publishers.

Dr. Walter will always be remembered with affection by those who knew him as a beloved and inspiring teacher. This was apparent even to those who first crossed his path after their youthfully receptive minds were nearing the all too comfortable point of satiety. His cheery presence never failed to enliven meetings with his colleagues or students, as well as gatherings untinged by professionalism. His scholarly accomplishments and unselfish interest in his chosen field of teaching were combined to produce a most stimulating personality.

CHARLES T. BRUES

RECENT DEATHS

DR. FRANK M. CHAPMAN, since 1942 curator emeritus of birds of the American Museum of Natural History, died on November 15 at the age of eighty-one years.

DR. ERNST THELIN, head of the department of psychology at Syracuse University, died on November 9 at the age of fifty-seven years.

DR. EDITH STEVENS, since 1928 a member of the department of biology at the Farmville, Virginia, State Teachers College, and associate professor since 1929, died on October 31, as a result of burns sustained in the laboratory.

DR. FRANCIS WILLIAM ASTON, fellow of the Royal Society and fellow of Trinity College, Cambridge, died on November 20 at the age of sixty-eight years.

SCIENTIFIC EVENTS

FELLOWSHIPS FOR EUROPEAN STUDENTS

THE Board of Governors of the International House voted at its last meeting to establish a limited number of fellowships for European students. These fellowships are being established to provide for scholars of exceptional ability an opportunity to resume their study and research, interrupted by the war. The board feels that such fellowships might provide mutual advantages to American universities and to the scholars themselves, during their stay in this country and upon their return to their homes.

The students selected must be graduate students with outstanding academic records, with a thorough knowledge of English and in good health. Students will not be limited to any specific fields of study. Each fellowship will provide a maximum of $1,300 with $300 of this set aside for the payment of room rent at International House in which the student selected will reside. Cash payments of $83.33 a month during a calendar year will be paid to the student to provide for his meals and expenses other than tuition. The University of Chicago, Northwestern University and the Illinois Institute of Technology will award tuition scholarships to the students selected. It is the hope of International House that transportation will be provided by the governments of the students selected or by other agencies, as no funds are provided by the International House for travel.

The fellowships are open to any student from Europe. The student's academic qualifications must be accepted through the regular channels for admission by one of the cooperating schools before he is eligible to receive a fellowship. These schools and the International House are anxious to see the best possible scholars selected for this project, as the success of the plan will depend upon the standards of selection established.

Recommendations may be sent to Robert M. Strozier, Associate Director, International House, Chicago 37, Illinois.

THE NATIONAL ACADEMY OF SCIENCES

PRESENTATION of the awards of the National Academy of Sciences was made at a dinner on Friday evening, November 16, at the Benjamin Franklin Hotel, Philadelphia.

CYRUS B. COMSTOCK PRIZE

Awarded every five years for the most important discovery or investigation in electricity, magnetism and radiant energy.

Prize of $3,000 for the period 1938 to 1943 awarded to Donald W. Kerst, Department of Physics, University of Illinois, Urbana, Illinois, for his pioneer work in connection with the development of the betatron and the results which he has obtained with this new and powerful scientific tool.

DANIEL GIRAUD ELLIOT MEDAL

Gold medal with certificate and honorarium for most meritorious work in zoology or paleontology published each year.

Awarded for 1941 to Theodosius Dobzhansky, Department of Zoology, Columbia University, New York City, in recognition of the high merits of his work "Genetics and the Origin of Species," second edition, published in 1941.

PUBLIC WELFARE MEDAL

Gold medal for eminence in the application of science to the public welfare.

Awarded for 1945 to Vannevar Bush, Director of the Office of Scientific Research and Development, Washington, D. C., in recognition of his outstanding service in bringing to bear the scientific and engineering talent of this country upon problems of research connected with the war effort.

THE PRODUCTION OF ELEMENTS 95 AND 96

IN reply to a wire requesting information in regard to the production of elements 95 and 96, the telegram given below has been received by SCIENCE:

The 60" cyclotron in the Radiation Laboratory of the University of California at Berkeley has been employed to effect the transmutation of Uranium Mass 238 and Plutonium Mass 239 into elements of atomic numbers 95 and 96, respectively.

In order to accomplish this task, the instrument was completely rebuilt by the group in the Crocker Laboratory, during the summer and fall of 1944, so that nuclear particles could be accelerated to higher energies than had been previously available.

The cyclotron was put back into operation in January 1945 and initially was capable of producing deuterons and alpha particles at measured energies of twenty and forty million electron volts, respectively.

During the next few months, Uranium 238 and Plutonium 239 were bombarded with forty million electron volt helium ions.

Element 95 was found to be produced in the Uranium targets and element 96 in the bombarded Plutonium sample.

The identity of these two elements was established by their chemical and radioactive properties.

This phase of the work was done by the Chemistry Group at the Metallurgical Laboratory at the University of Chicago.

Recently, the energy of the deuterons and alpha particles has been increased to measured values of 22 and 44 million electron volts, respectively.

GLENN T. SEABORG
METALLURGICAL LABORATORY,
UNIVERSITY OF CHICAGO,
(ON LEAVE FROM DEPT. OF CHEMISTRY,
UNIVERSITY OF CALIFORNIA AT BERKELEY)

JOSEPH G. HAMILTON, M.D.
RADIATION LABORATORY,
UNIVERSITY OF CALIFORNIA AT BERKELEY

NEWS FROM ABROAD

DR. C. JUDSON HERRICK writes:

Letters have been received by several American anatomists reporting the welfare of some European colleagues. Dr. C. U. Ariëns Kappers, director of the Central Institute for Brain Research, Amsterdam, informs us that he and his staff were permitted to continue work at the institute, though under harsh conditions. They are now recovering from malnutrition, are in good health and actively at work.

Dr. Jan Jansen writes from the department of anatomy of the University of Oslo that when the university was closed in November, 1943, seven hundred students and many of the faculty were deported to German concentration camps, but they were able to begin teaching on August 1 of this year. The rector was deported to a German concentration camp in September, 1941, but returned for the formal opening of the university on September 2, 1945. They immediately matriculated 6,300 students, which is more than twice the usual number. The two professors of anatomy, Schreiner and Mohr, were arrested in September, 1941, and spent many months behind the barbed wire without trial. Dr. Jansen was active in the publication of the underground newspaper from the beginning of 1940 and in the summer of 1942 he was the only one of that staff who escaped capture and deportation. His own activities continued and he was in Oslo, underground, at the time of the German surrender. Professor Schreiner is now retiring and Dr. Jansen succeeds him as head of the department of anatomy. On his staff he has Drs. Brodal, Heier and Cammermeyer.

Professor R. C. Coker, of the University of North Carolina, has received the following letter from Professor Dr. Chr. P. Raven:

I have the pleasure to inform you that the laboratory of general zoology of the State University of Utrecht has come through the war quite undamaged.

Alas, the assistant-in-chief, Dr. J. W. de Marees van Swinderen, succumbed in a German concentration camp; one of our co-workers, J. Kloos, was shot by the Gestapo;

the other members of the staff survived the terrors of 5 years of German occupation. Fortunately, we have been able to continue our scientific activity till the autumn of 1944. Then, the lack of fuel and the termination of the supply of gas and electric current made further work impossible; moreover, on account of the continual slave-raids most of us were enforced to remain at home.

After our liberation on the 7th of May we have resumed our work as soon as possible. We are, however, very much handicapped by the fact that we have been cut from our foreign communications and did not receive any scientific papers since 1940. Therefore, may I ask you to send me as soon as possible reprints of your papers of these years? When the dispatch of printed matter from our country is allowed, I will send you my papers and those of my co-workers in return.

Dr. Leon J. Cole, of the Department of Genetics, University of Minnesota, submits the following excerpts from a letter dated at Manila, P. I., August 27, 1945, from Dr. B. M. Gonzalez, president of the University of the Philippines:

Your news about Dr. Manresa's passing[1] is quite definite. We are in contact with Mrs. Manresa and she was the one who gave us the details. The first news was that Mrs. Manresa also died, but suddenly one day she turned up at the house with her little girl. I understand Dr. Manresa was showing his papers to a Japanese soldier when another one shot him with the muzzle of the gun directly on his temple. During the days just prior to the arrival of the American troops, the Japanese went into a frenzy of burning houses, killing people, and on some occasions even raping women. While some families suffered very heavily, the total loss of life even in the City of Manila was probably under five per cent. The destruction and damage to dwellings, however, was quite extensive. A fair estimate as to values is probably 70 per cent., and the average is as low as 20 per cent. in some districts and almost 100 per cent. in others. In so far as the material prosperity brought to the Islands through a half-century of American occupation is concerned, this has been largely destroyed. Spiritual values remain very high, although the strain due to conditions of war has revealed many characters. Fortunately, this has worked both ways, and inasmuch as positively good characters usually lead to survival while otherwise to extinction, the war might still be a blessing in disguise. The atmosphere just now is quite depressing, but the Filipino character is resilient and basically cheerful, so that the gloom is not as pervading as one might be led to think. Some days ago I asked one of our elder students what the comment was of the university among them; she said that the frequent remark was that if they only did not look at the ruins the university was the same as before.

I was recalled to the service of the university, . . . , on June 28th, and proceeded immediately towards the rebuilding of the university. Classes in Manila began on August 6 and in Los Baños a few days before that. Practically all the units of the university are now open except the junior colleges in Baguio and Cebu, the School of Fine Arts, the Conservatory of Music, the College of Business Administration and the School of Public Health Nursing. These last two were more or less colleges on paper even before the war, so that their remaining closed partakes largely of this nature also. The present enrollment is 1,800 as against a normal one of about 8,000. All in all, the situation is quite satisfactory. The university is housed in a patched-up building that we borrowed from the Philippine General Hospital, as well as in some of the laboratories of the same institution that escaped total destruction. Our libraries and laboratory equipment have been destroyed to the extent of about 95 per cent. At the time I took office, we did not even have seats for students nor blackboards nor chalk. We were able to salvage a few desks, tables and chairs for the faculty, and one or two typewriters. We are now gradually building up our equipment, but the process is greatly handicapped by lack of available materials in the market, and when these are obtainable, the prices are skyhigh. I was offered, for example, some office desks ranging in price from 900 pesos to 3,000 pesos. Similar furniture before the war could be obtained for from 25 pesos to 80 pesos. We use alcohol lamps made from used tin cans in the chemistry laboratories. The price of a five-gallon can of denatured alcohol before the war was about 1.50 pesos. We bought some recently and the price was 148.50 pesos. All these prices now are in the normal currency of the country. The guiding thought in our operations is that our young people have lost so much time that we cannot afford to wait to reopen until we are better equipped. The plan is to rebuild as we go along. We are fortunate in that most of our older faculty was with the university in its early days, so that they have seen it grow from practically nothing. I was a student in Los Baños when the institution had a faculty of five, carrying a curriculum of six years with practically nothing in the way of equipment. Compared to that, we are now nabobs with our ruins. It may take some years before we reach the stage of development where we left off. We are hoping that in some features of our work there might even be a distinct advance. Times change and there is naturally a call for reorientation in some of our program of work and even in our objectives. We aim to not only make the best of a bad situation but also to capitalize in some way our very misfortunes, and because of this I trust that this suffering need not all be in vain.

Dr. Harold St. John, professor of botany at the University of Hawaii, writes that Dr. Eduardo Quisumbing, botanist of the Bureau of Science, Manila, Philippine Islands, is resuming botanical work. He received this information from Lt. (j.g.) A. R. Kruckeberg, U.S.N.R., who recently visited Dr. Quisumbing and went on a field trip with him. Dr. Quisumbing is in good health and survived the Japanese occupation, as did his wife, son, and two daughters, though he lost his son-in-law. The Bureau of

[1] SCIENCE, August 10, 1945.

Science was deliberately destroyed during the Japanese evacuation and with it the library, herbarium and his personal books and manuscripts. He now is using an office in the Department of Agriculture and Commerce in the Binondo District, Manila.

A letter has recently been received by Cyril F. Dos Passos, research associate of the American Museum of Natural History, from Jean Bourgogne, assistant au Muséum National d'Histoire Naturelle, 45 bis, Rue de Buffon, Paris Ve, France, advising him of the death of Mr. Fd. Le Cerf during the past winter, after a short illness due in part to lack of heat and insufficient nourishment. His collection and his library are now at the Muséum National d'Histoire Naturelle.

Dr. Wm. Randolph Taylor, of the University of Michigan, writes that he has received a card dated August second from the Academy of Agriculture, Dotnuva, Lithuania, reporting that Dr. V. Vilkaitis, for some time subsequent to June, 1941, was concerned with the fishery industry in the Takutsk region of Siberia, but that a report of his death had been received from his widow. Dr. Vilkaitis is known for his work on the desmids of Lithuania.

A letter received by Walter N. Bangham, director of the Plant Research Department of the Goodyear Rubber Plantations Company, San Jose, Costa Rica, from the wife of the late Dr. A. D'Angremond, formerly director of the Experimental Station of the Algemeene Vereeniging van Rubberplanters ter Oostkust van Sumatra (AVROS) brings new evidence of the horrors perpetrated by the Japanese.

The AVROS station was an outstanding institution among many great experiment stations investigating tropical agricultural problems in the Netherlands Indies. In this station studies were made of better cultural and processing practices for the rubber plantation industry. Here were first developed many of the high-yielding Hevea clones which became planted in the rubber plantations around the world. It was in this station that generative breeding of Hevea was first started. One of the outstanding libraries of tropical agriculture was maintained and a journal, *Archief voor de Rubbercultuur,* was regularly published from 1919 until the time of the occupation of Sumatra by the Japanese.

Dr. D'Angremond had himself contributed greatly to the utilization of the improved clones. He carried the institution through a very difficult period during the years of low rubber prices. He was kindly, genteel and a lover of intellect. Dr. Schmole had made many contributions to the knowledge of the behavior of Hevea clones under various conditions, and had studied tapping procedure. The other men mentioned in the letter below have had a shorter stay at the AVROS station.

Mrs. D'Angremond's letter was from Aek Pamienko (Sumatra) Camp No. 1, and was dated September 22. It said:

(Please excuse the paper, I found a spare one). First of all, are you all right? Both of you? I hope so very much, for now that the terrible nightmare is lifting you should be together. This happiness was not meant for us, my dear husband succumbed to attacks of bacillary dysentery three weeks before we heard of Peace (20 Aug.) in the most terrible of civilian camps in Sumatra, Si Ringo Ringo (Rantau Prapat), owing to there being no more medicaments. The Japs did not think it necessary that we should correspond during the whole war. Indeed we were beaten and punished if they happened to catch our secret letters, but in the last year it was impossible to communicate. So that on the 25th of August, when the first lorries came, with the first men to come to their wives, I heard that he had been buried three weeks ago. This is especially hard, nearly coming through and just before Peace to have to go. As far as I know, for we are still in a terrible muddle, he passed away very quietly.

The AVROS Proefstation is in a very bad plight, Schmole, Van Dillen, Lankert, Rockland, and Ad . . ., too, all gone. I wonder what is going to happen to us. We . . . and I hoped to work some more and then go to live somewhere where it would be possible for me to work on my stories with his critic and help. Now I think I will go to Java, where our youngest daughter was staying, and from there to go on somewhere to a better climate. At least if I can pay for it, as our finances are in a very unlucky condition, owing to all the havoc in Europe, Holland and here. I hope for the best anyway and that I may be able to earn money with my plays and books. Not about the camps! Oh, no! Once out of all this rotten business I hope never more to have to hear about anything appertaining to it. I was in eight of them, quite enough.

I hope that this reaches you. I did not know any better way of addressing it. Now that we are getting more and better food, we are all most terribly ill, owing to the refined scientific way in which the Japs regulated our hunger diet, nothing but carbohydrates and that just enough to keep you from dying but also to prevent you to live. Hunger oed . . . is universal.—Well, God bless you, dear people. I hope that I may see you some time again but am afraid that it is impossible.[2]

ANNAMARIE D'ANGREMOND

Scientific staffs of other research stations throughout the Netherlands Indies may have suffered similar fates. If this is true, it will require many years to rebuild these institutions to their former preeminence in tropical agricultural research.

[2] Blank spaces were not legible in original.—W. N. B.

SCIENTIFIC NOTES AND NEWS

THE 1945 Nobel prize in physics has been awarded to Professor Wolfgang Pauli, of the Institute for Advanced Study at Princeton, N. J., for his work on the "exclusion principle," which deals with regulation of electrons in the outer shell of atoms and molecules. The 1944 prize in chemistry has been awarded to Professor Otto Hahn, Germany, an authority on radioactivity, for his discovery of a method of breaking the heavy atom nucleus. Artturi Wirtanen, of Finland, the biochemist, has received the 1945 award in chemistry for his discoveries relating to food chemistry.

A DINNER in honor of the seventieth birthday of Dr. Gilbert N. Lewis, for thirty-three years a professor of chemistry at the University of California at Berkeley, was given by members of the department of chemistry. Five years ago he relinquished the deanship of the College of Chemistry, which he had held for twenty-eight years. He was presented with a booklet in honor of the occasion.

THE Hayden Memorial Geological Prize of the Academy of Natural Sciences of Philadelphia for the three-year period ending with 1945 has been awarded to Dr. Joseph Augustine Cushman, director of the Cushman Laboratories at Sharon, Mass., in recognition of his work on foraminifera. Dr. Cushman will go to Philadelphia to receive the prize at ceremonies in the academy on a date to be announced.

MAJOR GENERAL NORMAN T. KIRK, the Surgeon General of the Army, presented on November 19 the Distinguished Service Medal to Brigadier General James Stevens Simmons, U.S.A., in recognition of his work as chief of the Preventive Medicine Service, Office of the Surgeon General, from November, 1939, to August, 1945.

THE gold medal of the Illuminating Engineering Society, awarded for "meritorious achievement conspicuously furthering the profession, art, or knowledge of illumination engineering," was presented recently at a joint meeting with the American Institute of Electrical Engineers to Preston S. Millar, president of the Electrical Testing Laboratories of New York City.

PURDUE UNIVERSITY, at its eighty-first commencement, conferred an honorary degree on Dr. Ira L. Baldwin, dean of the College of Agriculture of the University of Wisconsin, in recognition of his outstanding work in the fields of science and agriculture.

DR. F. B. PLUMMER, professor of petrology in the University of Texas, was elected president of the Texas Academy of Sciences at the annual meeting of the academy, which was held at Waco on November 10. Dr. C. M. Smith, curator of the Museum of Baylor University, was elected secretary, and Dr. Don O. Baird was reelected as representative of the American Association for the Advancement of Science.

DR. MAX CUTLER, director of the Chicago Tumor Institute, has been elected an honorary member of the Cuban Radiological Society.

BRIGADIER GENERAL JAMES STEVENS SIMMONS, U.S.A., chief of the Preventive Medicine Service of the Office of the Surgeon General, U.S.A., was elected president for the year 1945–46 of the American Academy of Tropical Medicine at its twelfth annual meeting, held on November 14 at Cincinnati, Ohio. On November 15 he was also made president of the American Society of Tropical Medicine.

DR. FREDERICK B. LLEWELLYN, consulting engineer on the staff of the Bell Telephone Laboratories, has been elected president of the Institute of Radio Engineers for the year 1946. He succeeds Dr. William L. Everitt, head of the department of electrical engineering of the University of Illinois.

THE annual meeting of the Connecticut Academy of Arts and Sciences was held in New Haven, on November 15. Officers for the year 1945–1946 were elected as follows: *President,* Alexander Petrunkevitch; *Vice-presidents,* G. Evelyn Hutchinson, Frederick A. Pottle and Herbert Thoms; *Secretary,* G. F. Eaton; *Treasurer,* Laurence G. Tighe; *Librarian,* James T. Babb; *Publication Committee*—the president, the vice-presidents, the secretary, the librarian and Alfred R. Bellinger and Sydney K. Mitchell.

AT the annual meeting on October 26 and 27 in New York City, the Society of Rheology elected the following officers: *President,* Dr. W. F. Fair, Jr.; *First Vice-president,* Professor J. W. McBain; *Second Vice-president,* Professor Henry Eyring; *Secretary-Treasurer,* Dr. R. B. Dow; *Editor,* Dr. W. H. Markwood, Jr., and *Publishing Editor,* Dr. Turner Alfrey.

THE Eastern Missouri Chapter of the Society of American Bacteriologists held its twenty-fourth regular meeting on November 6. Dr. Robert A. MacCready, Captain, Medical Corps, A.U.S., Jefferson Barracks, Missouri, spoke on "The Serological Identification of a Salmonella Culture," and Dr. Homer Whitmire on the "Public Health Aspects of the Control of Some Insect Vectors." Dr. R. O. Meuther was elected *President;* John A. Doubly, *Vice-president;* Mrs. Grace Montrose McCrary, *Secretary-treasurer,* and Dr. John B. Rehm, *Councilor.*

DR. DUDLEY B. REED, professor of hygiene in the School of Medicine of the University of Chicago, has retired with the title emeritus, after having been connected with the school for thirty-four years.

IN the department of mathematics at Princeton University, Dr. Luther P. Eisenhart, dean of the Graduate School and chairman of the department, and Dr. J. H. M. Wedderburn, professor of mathematics, have retired with the rank of professor emeritus; Dr. S. Lefschetz, Henry Burchard Fine professor, has been appointed chairman of the department; Dr. D. C. Spencer, associate professor of mathematics at the University of California, has been appointed associate professor and will assume his duties in the spring; Dr. Samuel Eilenberg, associate professor of mathematics at the University of Michigan, has been appointed lecturer for the winter term; Dr. Max Shiffman, of the College of the City of New York, has been appointed lecturer for the spring term, and Dr. George W. Whitehead, of Purdue University and Aberdeen Proving Ground, has been appointed Fine instructor in mathematics for the academic year 1945–1946.

DR. LISE MEITNER, the Austrian physicist, will join in February the faculty of the Catholic University of America, where he is visiting professor.

DR. CURTIS H. WALDON, professor of pharmacology at the School of Pharmacy of Purdue University, has been made dean of the School of Pharmacy of Montana State University.

DR. HAROLD HOWE, professor of agricultural economics and land economist, has been appointed dean of the Graduate School of Kansas State College at Manhattan to succeed Dr. James E. Ackert, who is retiring.

DR. MILTON WOODBURN, for twenty-two years a member of the faculty of the University of Buffalo, has become head of the department of chemistry.

DR. WILLIAM A. MOSHER, assistant to the director of research of the Hercules Powder Company, has been appointed professor of chemistry and head of the department at the University of Delaware.

DR. ALBERT H. COOPER, on leave as a captain in the Chemical Warfare Service, has been appointed professor of chemical engineering and chairman of the department at the University of Denver.

DR. G. W. BEADLE, of Stanford University, has been appointed professor of biology and chairman of the Division of Biology of the California Institute of Technology. He will take up the work on July 1, 1946.

AT Cornell University, Dr. Harold H. Williams, associate director of the Research Laboratory at Detroit of the Children's Fund of Michigan, has been appointed professor of biochemistry. Effective on October 1, Dr. George C. Kent, research associate professor in botany and plant pathology in the Experiment Station of Iowa State College, has been appointed professor of plant pathology.

DR. H. K. WILSON, professor of agronomy at the University of Minnesota, has become head of the department of agronomy of Pennsylvania State College. He succeeds Dr. C. F. Noll, who has retired with the title of professor emeritus.

DR. GEORGE A. GRIES has been made associate professor of botany and plant pathology and associate plant physiologist at the Agricultural Experiment Station of Purdue University. For three years previously he had been connected with the Connecticut Agricultural Experiment Station at New Haven.

DR. JAMES H. M. HENDERSON, who for the past two years has been carrying on war research at the University of Chicago, has become assistant professor in chemistry and agriculture, and a member of the research staff of the George Washington Carver Foundation at Tuskegee Institute, Alabama.

DR. JACK G. ROOF has returned to his position as assistant professor of physical chemistry at the Oregon State College after three and a half years spent in research connected with the war program at the Technological Institute of Northwestern University, at Panama and at Edgewood Arsenal.

DR. VINCENT W. COCHRANE, of the Lederle Laboratories at Pearl River, N. Y., has recently been appointed assistant plant pathologist at the Connecticut Agricultural Experiment Station, to fill the vacancy left by the resignation of Dr. George A. Gries.

DR. FRANK G. VIETS, JR., has resigned as associate agricultural chemist of the South Dakota Agricultural Experiment Station to become agronomist in the Division of Soils, Fertilizers, and Irrigation, U. S. Department of Agriculture, at the Irrigation Branch Experiment Station, Prosser, Washington. Dr. Louis W. Holm, of the University of Chicago Toxicity Laboratories, has been appointed associate agricultural biochemist.

DR. E. M. MRAK, associate professor of food technology, has resumed his work at the University of California at Berkeley after having completed his assignment as chairman of the committee on food research of the military planning division, office of the Quartermaster General. The committee on food research organized a program of scientific investigation in connection with the Army food program, which was

carried out in the various commercial, university and government laboratories.

DR. WILLIAM A. SHURCLIFF, of the Office of Scientific Research and Development, who served for eight years as acting head of the laboratory of physics of the American Cyanamid Company, has been named technical consultant to the Bureau of Industry of the New York State Department of Commerce.

DR. FRANK J. RUDERT, Ph.D. (Cornell), has joined the Merrell Research Laboratories to study the development of new antibiotics.

DR. J. H. SIMONS, professor of physical chemistry at Pennsylvania State College, has been appointed director of the Fluorine Research Laboratories.

PROFESSOR EMERITUS WILLIAM H. HOBBS, of the University of Michigan, has returned from a month's field season spent in mapping the now abandoned shore-lines of Glacial Lake Leverett, which was discovered in 1943 (SCIENCE, September 10, 1943, pp. 227–230).

THE special committee on atomic energy of the Senate opened hearings beginning on Monday, November 26. Among the witnesses were Dr. Vannevar Bush, director of the Office of Scientific Research and Development; Dr. Harold Urey, professor of chemistry at the University of Chicago; Dr. Irving Langmuir, associate director of the Research Laboratories of the General Electric Company at Schenectady; Dr. E. P. Wigner, Thomas P. Jones professor of physics at Princeton University; Dr. H. D. Smyth, reseach chemist of Carleton and Hovey Company; Dr. Edward U. Condon, now director of the National Bureau of Standards, and representatives of government, labor and agriculture.

WALTER N. BANGHAM, director of the plant research department of the Goodyear Rubber Plantations Company, San José, Costa Rica, has recently returned from a two-week visit to the El Palmar area of Mexico, where he made a survey of planting practices on the Hevea Plantations for the Secretaria de Agricultura y Fomento, Mexico.

DR. JOHN B. LUCKE has returned to his work as associate professor of geology and head of the department of geology and geography at the University of Connecticut. During the past year, as Lieutenant, U.S.N.R., he was photo interpretation officer in charge of terrain and beach studies at the Joint Intelligence Center, Pacific Ocean Areas, Pearl Harbor, T. H.

ANTHONY PUGLIESE, A.U.S. retired, assistant professor of design at Brooklyn College, has returned from military leave. He is an honorary member of the Armée de l'Air Français. He will divide his time between the Veterans' and War Counseling Office and studio classes in the department of design.

PROFESSOR ROGER ADAMS, head of the department of chemistry of the University of Illinois, and chairman of the board of directors of the American Chemical Society, has been appointed special adviser to Lieutenant General Lucius DuB. Clay, deputy military governor of Germany and U. S. deputy member of the Allied Group Control Council in Berlin.

DR. ALLEN B. SCOTT has returned to his position as instructor in chemistry at the Oregon State College after four years of military service. He was separated with the rank of captain in the artillery of the Seventieth Division and was decorated with the Bronze Star medal.

The British Medical Journal reports that Professor R. P. Linstead, F.R.S., has been appointed director of the chemical research laboratory in the Department of Scientific and Industrial Research. He was formerly Firth professor of chemistry in the University of Sheffield and in 1939 was elected to the chair of chemistry of Harvard University. During the war he returned to Great Britain.

SPECIAL ARTICLES

THE RELATION BETWEEN EPIDEMICS OF ACUTE BACTERIAL PNEUMONIA AND INFLUENZA[1]

THERE is insufficient knowledge of the underlying causes of the localized epidemics of pneumonia which are known to occur in institutions, camps, rural areas, families and hospital wards.[2] In the present paper the possibility will be discussed that some of these localized outbreaks of bacterial pneumonia are related to epidemic influenza. One instance of a laboratory confirmation of this hypothesis will be reported.

According to Collins and Gover[3, 4] 16 widespread epidemics of influenza have occurred in the United

[1] This investigation was supported in part through the Commission on Acute Respiratory Diseases, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of The Surgeon General, United States Army, and by grants from the Commonwealth Fund, the W. K. Kellogg Foundation, the John and Mary R. Markle Foundation and the International Health Division of the Rockefeller Foundation to the Board for the Investigation and Control of Influenza and Other Epidemic Diseases for the Commission on Acute Respiratory Diseases.

[2] M. Finland, *Medicine*, 21: 307–344, 1942. (Includes an extensive bibliography of reported epidemics.)

[3] S. D. Collins, *Pub. Health Rep.*, 45: 361–406, 1930.

[4] Mary Gover, *Pub. Health Rep.*, 58: 1033–1061, 1943.

States between the years 1920 and 1944. At least 6 of these have been nationwide in extent, while the remaining 10 have been recognized in 4 or more of the 9 geographic areas of the country as designated by the United States Public Health Service. During each of the 8 epidemics which have occurred since 1932 the presence of specific influenza type A or B has been demonstrated by virus isolations or by serological methods or both.[5, 6]

A sharp increase in mortality from pneumonia has accompanied each epidemic of influenza.[3, 4] The specific etiology of these pneumonias is apparently varied. It is the common experience of clinicians that an unusually large number of pneumococcal and other bacterial pneumonias occur during these periods.[7] There can be little question that in some manner an epidemic of influenza leads to a high incidence of bacterial infections of the respiratory tract.

A review of the localized epidemics of type specific pneumonia which have been reported in recent years reveals that most of these have occurred during the periods of widespread influenza infection.[2] Smillie, Warnock and White[8] indicate that influenza A infection occurred during an epidemic of type I pneumonia in a mental institution in Massachusetts in 1937. Finland, Peterson and Strauss,[9] and Pearson, Eppinger, Dingle and Enders[10] have reported the association of influenza A with both staphylococcal and pneumococcal pneumonia during the epidemic in Boston in 1940–41. The outbreaks of pneumonia which have occurred in camps and institutions have usually been preceded by waves of influenza-like infection, although the specific causes of such infections have only seldom been identified.

In epidemics in rural areas or villages, the concurrence of influenza-like illnesses has been reported less frequently. Such an outbreak was studied by Rogers, Bahlke and Harris[11] in Northville, N. Y., in 1940. There were 11 cases of pneumonia in a population of approximately one thousand people. Of these, 8 were due to type I pneumococcus. The cases occurred during a five-month period from December, 1939, to April, 1940. As a part of this study a sample comprising approximately one fourth of the total population was interviewed at monthly intervals, between January and May for a history of acute illness. An estimate for this period for the town as a whole based on these histories disclosed approximately 156 cases of acute respiratory disease with grippe-like symptoms and 148 cases of mild gastro-enteritis which epidemiologically seemed to be spread by the respiratory route. It seemed likely, however, that this incidence was not above the endemic level for these conditions in a rural community.

Blood specimens were secured from more than 100 individuals of this sample, during February, March or early April, and second specimens were obtained approximately four to six weeks subsequently. These bloods were collected for the purpose of studying pneumococcal antibodies.[11] Many of these sera, particularly those from the cases of pneumonia and the carriers of type I pneumococcus, were exhausted in these tests. Recently, the 55 sets of sera which remained were studied for antibodies to influenza A and B. The chicken erythrocyte agglutinin-inhibition test of Hirst[12] was employed for all the sera and a confirmatory mouse neutralization test was used in 3 instances.

The results are shown in Table 1. There were

TABLE 1

CHANGES IN TITER OF ANTIBODIES TO INFLUENZA TYPES A AND B IN 55 SETS OF SERA COLLECTED FROM A SAMPLE OF THE NORMAL POPULATION, NORTHVILLE, N. Y., FEBRUARY TO MAY, 1940

Change in titer	Number of individuals	
	Type A	Type B
Decreases		
Four-fold		
Two-fold	1	3
No change	50	42
Increases		
Two-fold	4	6
Four-fold		2
Eight-fold		2
Total	55	55

two-fold increases in antibody to influenza A. These slight rises in the absence of any greater increases in antibody are of doubtful significance. There were, however, 2 four-fold rises and 2 eight-fold rises in titer to influenza B. Three of these 4 "diagnostic" increases were confirmed by mouse neutralization tests. Insufficient serum was available to test the fourth. Thus 4 individuals, 7 per cent. of the sample, suffered from infection with influenza B during the interval between which the blood specimens were taken. The findings in this small group indicate that influenza B existed in the community during the winter and spring of 1940.

DISCUSSION

The demonstration of influenza B in Northville, N. Y., is of some interest because Francis[13] and

[5] T. Francis, SCIENCE, 97: 229–235, 1943.

[6] J. E. Salk, W. J. Menke and T. Francis, *Jour. Am. Med. Asn.*, 124: 93, 1944.

[7] M. Finland, M. W. Barnes and B. A. Samper, *Jour. Clin. Invest.*, 24: 192–208, 1945.

[8] W. G. Smillie, G. H. Warnock and H. J. White, *Am. Jour. Pub. Health*, 28: 293, 1938.

[9] M. Finland, O. L. Peterson and E. Strauss, *Arch. Int. Med.*, 70: 183–205, 1942.

[10] H. E. Peterson, E. C. Eppinger, J. H. Dingle and J. F. Enders, *New England Jour. Med.*, 225: 763–770, 1941.

[11] E. S. Rogers, A. M. Bahlke and A. H. Harris, *Am. Jour. Pub. Health*, 33: 671–681, 1943.

[12] G. K. Hirst, *Jour. Exp. Med.*, 75: 49–64, 1942.

Magill[14] first isolated this virus during the same season and year in other parts of New York State. A widespread prevalence of influenza, however, was not recognized in this region at that time. According to the study of "excess pneumonia mortality"[4] which is the usual criterion for indicating the prevalence of influenza, the epidemic of 1940 was limited to the South Atlantic and some of the Central States. Clearly these mortality studies do not demonstrate the full extent to which influenza may occur. It is becoming increasingly apparent that influenza may be present in some communities without attracting particular attention.

The association of influenza B with this outbreak of pneumococcus pneumonia raises the possibility that many of such localized epidemics may be secondary manifestations of influenzal infections. This idea is supported by the fact that most of the reported outbreaks of pneumonia have occurred during the years when widespread epidemics of influenza have been known to be present. Other factors also must be considered, such as the prevalence of carriers of type specific pneumococci in the population, the pathogenicity of the particular strains, and the immunity status of the population to such strains. It seems quite possible, however, that the presence of influenzal infection may be one of the determining factors. Whether the influenzal infection may predispose directly to the development of pneumococcal infection in particular cases, or may enhance the transmission of the specific pneumococci among the population, or both, remains to be elucidated.

Epidemics of pneumonia in institutions have usually been as explosive in character as epidemics of influenza. Some rural outbreaks of pneumonia, however, and the Northville outbreak in particular, have been protracted. Cases have occurred over a period of several months or throughout the "respiratory season." It is difficult to reconcile this protracted course with the usual short duration of influenza epidemics. It is possible that (1) the apparent susceptibility to pneumonia which is produced by influenza infection lasts for several months, or (2) in rural areas influenza epidemics may continue for a longer period than has been generally appreciated, or (3) some of the cases of pneumonia may have resulted independently of influenzal infection.

Epidemics of pneumonia have occurred in the absence of known wide-spread influenza. One of these developed in Wyoming County, N. Y. during the winter of 1937–38.[15] Neither influenza A nor B was reported from any part of the country during this period. The sporadic occurrence of single cases and small outbreaks of influenza A and B, however, are now being discovered with increasing frequency.[6, 16, 17, 18, 19, 20] Localized outbreaks of pneumonia in the absence of recognized prevalence of influenza might result: (1) from the occurrence of such small outbreaks of influenza A or B, or (2) from the prevalence of other, as yet unidentified respiratory diseases, or (3) from other causes independent of a preceding or concurrent respiratory infection.

Aside from these hypothetical considerations, the findings in the Northville sera clearly indicate that an increased prevalence of pneumonia may be a useful clue to identifying and studying outbreaks of influenza.

Summary

The presence of influenza B infection during an epidemic of type I pneumococcus pneumonia in Northville, N. Y., in 1940 has been reported. The possibility is discussed that some localized outbreaks of acute bacterial pneumonia are secondary manifestations of influenza epidemics.

COMMISSION ON ACUTE RESPIRATORY DISEASES[21]
FORT BRAGG, N. C.

AND

THE NEW YORK STATE DEPARTMENT OF HEALTH[22]
ALBANY, N. Y.

ON THE IN VITRO PROTEOLYSIS OF EGG WHITE[1]

RECENT investigations on the nutritional value of various proteins have renewed interest in the properties of egg proteins. Murlin[2] has reported high biologic value for egg white in humans and various unpublished experiments on dogs have come to our attention. Since some of this work has involved the use of dried egg white it has seemed worthwhile to

[13] T. Francis, Jr., SCIENCE, 92: 405–408, 1940.

[14] T. P. Magill, *Proc. Soc. Exp. Biol. and Med.*, 45: 162–164, 1940.

[15] New York State Health Department, unpublished studies.

[16] C. Nigg, C. M. Eklund, D. E. Wilson and J. H. Crowley, *Am. Jour. Hyg.*, 35: 265–284, 1942.

[17] F. M. Burnet, *Med. Jour. Australia*, 11: 393–398, 1943.

[18] R. Hare, J. Hamilton and W. R. Feasby, *Can. Jour. Pub. Health*, 34: 453, 1943.

[19] C. H. Stuart-Harris, R. E. Glover and K. C. Mills, *Lancet*, 790, December 25, 1943.

[20] Commission on Acute Respiratory Diseases, unpublished data.

[21] Members and associates of the Commission on Acute Respiratory Diseases are: John H. Dingle, Major, M.C., A.U.S., Director; Theodore J. Abernethy, Major, M.C., A.U.S.; George F. Badger, Major, M.C., A.U.S.; Joseph W. Beard, M.D.; Norman L. Cressy, Major, M.C., A.U.S.; A. E. Feller, M.D.; Irving Gordon, M.D.; Alexander D. Langmuir, Major, M.C., A.U.S.; Charles H. Rammelkamp, Jr., M.D.; Elias Strauss, Captain, M.C., A.U.S.

[22] Division of Communicable Diseases and Division of Laboratories and Research.

[1] These experiments were carried out with the assistance of Miss Jeanne D. Medler.

[2] J. R. Murlin, L. E. Edwards and E. E. Hawley, *Jour. Biol. Chem.*, 156: 785, 1944.

study the *in vitro* digestibility of this protein in comparison with raw (undried) egg white and coagulated egg white.

The existence of an anti-tryptic principle in raw, undried egg white has been conclusively demonstrated[3] and our first experiment was designed to show whether this principle existed in the commercially dried product. Thereafter, comparison of the course of peptic digestion of the dried and undried egg white with that of coagulated egg white was undertaken. Experiments by Frank[4] have shown that the course of peptic digestion is affected by the conditions of coagulation. In the experiments to be described attempts were made to hold this factor constant in successive trials.

All tests were carried out at 37° ±1° C. using a commercial sample of dried egg white[5] and locally purchased fresh eggs as the source of undried and coagulated egg white. Enzymes were regular commercial samples of hog pancreatin and pepsin, each studied at its respective pH optimum. Criteria of digestion were, for pancreatic digestion, the increase in nitrogen not precipitable in 7.5 per cent. trichloroacetic acid and, for peptic digestion, the increase in nitrogen not coagulable by heat and acid.

Table 1 shows that commercially dried egg white

TABLE 1

PANCREATIC DIGESTION OF VARIOUS EGG WHITE PREPARATIONS

	Raw egg white		Coagulated egg white
	Undried	Dried	
Total N mg/cc	2.78	2.63	2.61
Ratio, substrate N : enzyme N	60	57	57
Time	% total N soluble in 10 per cent. trichloroacetic acid		
0 hr.	4.0	3.8	4.3
2 "	4.0	4.3	20.4
8 "	4.2	4.4	35.4
24 "	4.8	5.1	43.0

All solutions were adjusted to pH 7.3–7.4 and maintained within that range during the experiment.

contains about as much antitryptic principle as fresh (undried) egg white. The data of Table 2 show that, under the conditions studied so far, no real difference exists between the courses of peptic digestion of dried and undried raw egg white, but both are inferior in digestibility to coagulated egg white.

Further experiments are in progress to establish conditions within the physiologic range necessary to inactivate the anti-tryptic principle in raw egg white.

[3] H. A. Balls and G. L. Swenson, *ibid.*, 106: 409, 1934.
[4] P. Frank, *ibid.*, 9: 463, 1911.
[5] The dried egg white preparation was a Swift product used in dog-feeding experiments conducted by Dr. James B. Allison at Rutgers University. Grateful asknowledgment is made to Dr. Allison for this material.

TABLE 2

PEPTIC DIGESTION OF VARIOUS EGG WHITE PREPARATIONS

	Raw egg white		Coagulated egg white
	Undried	Dried	
Time	% increase in non-heat and acid coagulable N		
1 hr.	61	56	98
2 "	88	90	127
4 "	138	143	195

All mixtures were maintained at pH 1.8. Commercial hog pepsin (1 : 10,000) was used in the approximate ratio of 1 part pepsin N to 1,000 parts substrate N.

Haurowitz *et al.*[6] have very recently suggested the possibility that impaired gastric function (achylia) may prevent utilization of undenatured globular proteins by the animal organism. Their experiments, carried out with crystalline trypsin on native and denatured proteins freed of anti-tryptic principles, have interesting theoretical implications. It is desirable to supplement their studies with experiments, such as those recorded here where conditions more nearly simulate those encountered in physiologic digestion.

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EFFECT OF CONCENTRATED UREA SOLUTION ON THE PRECIPITATING POWER OF ANTIOVALBUMIN: SIGNIFICANCE OF FORMATION OF PROTEIN COMPLEXES

IN order to study the effect of protein denaturing agents on antibodies, it is usually necessary to remove such agents before testing the resulting material for antibody activity. Interpretation of the results must take into consideration, therefore, not only the possible destruction of the intrinsic structure of the antibody molecule, but also secondary effects which occur upon removal of the denaturing agent. There is considerable evidence[1] that aggregation or complexing of protein molecules occurs during certain types of denaturation or upon removal of denaturing agents and that aggregates of various dimensions and solubilities are formed. Those aggregates or complexes which are insoluble except in relatively concentrated dispersing solutions such as strong acids, bases, thiocyanates, etc., are referred to as irreversibly denatured, while the relatively soluble materials are designated either as native (unaffected) or "renatured" protein. However, it is generally true that

[6] F. Haurowitz, M. Tunca, P. Schwerin and V. Goksu, *Jour. Biol. Chem.*, 157: 621, 1945.
[1] Discussed in review by Hans Neurath, J. P. Greenstein, F. W. Putnam and J. O. Erickson, *Chem. Rev.*, 34: 157, 1944.

solutions of the latter type are not identical to solutions of untreated protein. Solutions of these so-called renatured proteins often show properties which clearly indicate that some aggregation has occurred and hence it becomes highly important to consider this possibility in any interpretation of studies dealing with the effect of denaturation on the physical or chemical activity of protein molecules. This is especially true when dealing with such a reaction as that of antigen-antibody precipitation. For example, one might expect that, under certain conditions, complexing of antibody with excess non-antibody protein would result in a non-reactive antibody mixture due merely to the covering of antibody combining sites rather than to any actual destruction of the antibody molecule. Furthermore, under certain conditions the amount of precipitable "antibody protein" might actually increase due to the complexing of antibody and non-antibody protein, but with enough specific combining sites exposed to afford the formation of a framework and subsequent precipitation. Highly purified antibody would show no change attributable to complexing, since there would always be plenty of combining sites exposed. It is possible, however, that under such conditions the destruction of a considerable number of combining sites would be masked by complex formation, since the resulting aggregates would have sufficient combining sites to give precipitation.

Studies on the significance of complexing of denatured antibody systems have been limited almost entirely to the work of Kleczkowski and co-workers,[2] who published a series of papers on the effect of heat denaturation on various antibody preparations. Much of the loss of antibody activity which they obtained was attributed to complexing of antibody protein with serum albumin. Although Erickson and Neurath,[3] in a report on guanidine hydrochloride denaturation of antipneumococcus serum, failed to consider the possibility of complexing, it is of interest that their "regenerated" antibody was almost as active as native antibody and the so-called inversibly denatured antibody showed a greater precipitating power than native antibody tested under similar conditions.

Our own studies on the effect of concentrated urea on the precipitating power of a variety of antibodies leave little doubt that complexing takes place upon removal of urea. This was evident because urea-treated preparations often showed an increase in the amount of precipitable protein at optimum antigen-antibody concentrations, and because the effect was dependent to a significant degree upon the protein treatment with urea. The work reported here deals entirely with studies on rabbit antiovalbumin. A more detailed report dealing with antiovalbumin as well as antibodies against arsaenilic acid, pneumococcus polysaccharide and diphtheria toxin will be published later.

Three types of antiovalbumin preparations were studied, namely, whole antiserum, antibody which had been partially purified by ammonium sulfate precipitation[4] and antibody which had been isolated from a specific precipitate by acid dissociation.[5] All preparations came from a pool of fresh rabbit serum which showed an optimum proportion zone of 1:6,000 and 2.0 mg of antibody per ml of whole serum. Each type of preparation was treated in three different protein concentrations (see Table 1). Solid urea was added to each sample to give a final concentration of 8 molar. The solution was then adjusted to pH 8.0 and allowed to stand at room temperature for 48 hours. The urea was then removed by dialysis against 1.0 per cent. NaCl solution and the protein concentration was adjusted to a uniform value before making the precipitation tests. The tests were made in the usual manner, using twofold dilutions of antigen, and the resulting precipitates analyzed for nitrogen as described by Pressman.[6]

TABLE 1

THE EFFECT OF UREA ON THE PRECIPITATING POWER OF RABBIT ANTIOVALBUMIN

Type of antibody preparation	Per cent. protein during urea treatment	Ratio of treated to untreated*
Whole serum	5.80	0.00
	1.36	0.89
	0.58	1.05
Partially purified antibody	5.00	1.28
	1.00	1.19
	0.50	1.05
Specifically† purified antibody	2.94	1.01
	0.58	0.98
	0.29	1.02

* Ratio of amount of precipitate obtained in urea-treated sample to amount obtained in untreated sample.

† Approximately 93 per cent. of the untreated total protein precipitated at optimum antigen concentration.

The results obtained are summarized in Table 1. Comparison is made as a ratio of the maximum amount of precipitate obtained with treated preparation with maximum amounts obtained with untreated controls. The sample of undiluted whole serum (5.8 per cent. protein) failed to give a precipitate in any antigen dilution, although there was a zone showing

[2] A. Kleczkowski, *Brit. Jour. Exp. Path.*, 22: 1921, 1941; F. C. Bawden and A. Kleczkowski, *Brit. Jour. Exp. Path.*, 23: 178, 1942; A. Kleczkowski, *Biochem. Jour.*, 37: 30, 1943.

[3] J. O. Erickson and Hans Neurath, SCIENCE, 98: 284, 1943.

[4] Use was made of the fraction obtained at one third saturation with salt. The precipitable antiovalbumin protein was 38 per cent. of the total protein.

[5] Details on the specific purification of various types of antibodies will be given elsewhere. In this particular preparation 93 per cent. of the total protein was precipitable.

[6] David Pressman, *Ind. and Eng. Chem.*, 15: 357, 1943.

faint turbidity in 24 hours. When the concentration of whole serum was reduced to 1.36 per cent. protein during urea treatment, the resulting material showed an activity of 89 per cent. of the activity shown by untreated serum. When the protein concentration was reduced to 0.58 per cent., the activity of the resulting material was approximately the same as the untreated control. The partially purified antibody showed the greatest effect of protein concentration—the 5 per cent. solution giving 28 per cent. more precipitate than the untreated control. Increases of 20 to 40 per cent. have been obtained with most systems of this type or where small amounts of serum albumin were added to purified antibody preparations. The third preparation, which consisted of highly purified antibody, showed essentially no effect from the urea treatment. In no case was there any significant change in the equivalence zone. However, the zones were usually much sharper for the urea-treated preparations.

These results indicate that when there is a large excess of non-antibody protein, optimum conditions for complexing of proteins will tend to eliminate precipitating activity due to masking of combining sites. When there is a relatively large amount of antibody protein present, complexing tends to increase the apparent precipitability of the antibody preparation because of complexing with non-antibody protein but with sufficient combining sites exposed to afford the formation of a precipitating framework. When the antibody is essentially pure, complexing has little or no effect on the resulting preparation. It is apparent, therefore, that considerable care should be exercised in the interpretation of data obtained for denaturation of antibodies, not only with urea but also any denaturing agent which causes the formation of protein complexes.

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CALIFORNIA INSTITUTE OF TECHNOLOGY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE TECHNIQUE OF INDUCING SPAWNING IN HALIOTIS RUFESCENS SWAINSON

IN April, 1940, an investigation into the life history of *Haliotis rufescens,* the commercial abalone of California, was initiated at the Hopkins Marine Station of Stanford University. In September of the same year the program was interrupted when the writer accepted temporary employment with the California State Division of Fish and Game. Due to subsequent enlistment in the armed forces, resumption of the work has been indefinitely postponed. It is, therefore, deemed advisable to present the following brief notes on the solution of one difficult problem, lest all results be lost.

Haliotis rufescens is a dioecious gastropod mollusk. Tide-pool and shallow-water observations made in the spring of 1940 revealed that the expulsion of sexual products by the male was of common occurrence, usually easily induced by disturbing the specimen. During any period of desiccation following removal of specimens from their habitat, large quantities of sperm were liberated. Similar treatment, however, never resulted in the liberation of eggs by the females.

Although the difficulty of inducing ovulation in this species has caused the abandonment of at least two previous attempts at an embryological investigation, numerous means were tried in an effort to solve the problem. Methods as drastic as the injection of KCl isotonic with sea water, a technique employed successfully by Dr. Albert Taylor,[1] of the California Institute of Technology on various mollusks, failed. After various methods had been tried with negative results, the following technique was arrived at as a successful method to induce spawning and fertilization.

For each experiment 15 to 20 specimens of both sexes were taken in the littoral waters, varying in depth from four to 18 feet. Since exposure to air was found to be necessary for the success of induced spawning, these animals were brought to the laboratory dry in large tubs. A period of desiccation totalling one hour and fifteen minutes was finally found to represent the optimum time for exposure to air. During this period large quantities of sperm were given off by all male specimens. This sperm was thoroughly washed over the entire body of each female; then all individuals of both sexes were placed in well-aerated salt-water tanks. These concrete tanks were out of doors and simulated quite well the natural environment of the species under discussion. Sperm continued to issue from the males until the water became cloudy and, in successful experiments, spawning of the females occurred within six to eight hours after placing the animals in the tanks.

Fertilization resulted in obtaining of typical mollusk cleavage stages. Development continued until trochophore larvae appeared, each still enclosed in a thin membrane. These membranes were finally ruptured and the trochophores became extremely active free-swimming larvae. Changes continued through the veliger stage, paralleling somewhat the develop-

[1] Personal communication.

ment of *Patella* as described by Patten.[2] The shell first appeared on the second day, and by the seventh day resembled closely the shell of small metamorphosed specimens collected in the field.

Considerable material and data are at hand and it is hoped that the work may be resumed, and that a full report on the embryology and larval development of this species can be presented at a later date.

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A BOX TRAP FOR COTTON RATS[1]

THE demand for wild caught cotton rats of the genus *Sigmodon* for research on the chemotherapy of filariasis has stimulated the trapping of these animals in various southern localities. The box trap shown in Fig. 1 has proved sufficiently successful in practice as

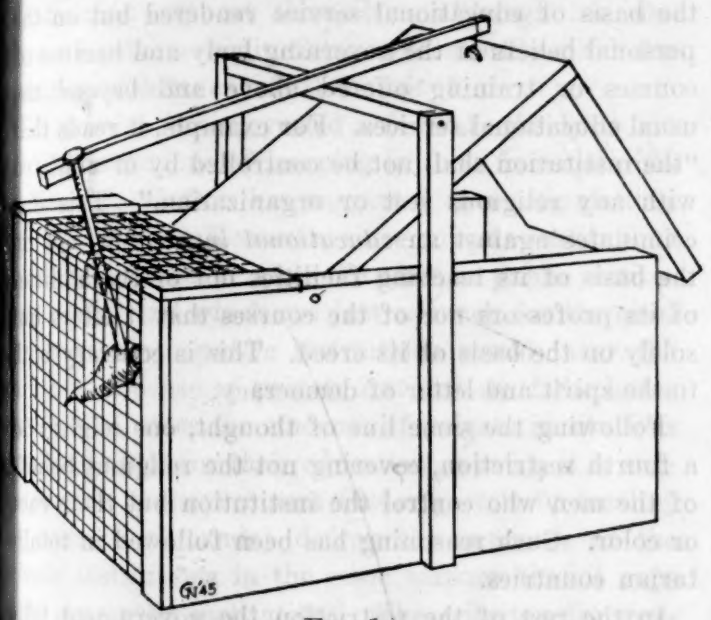

FIG. 1

to warrant making its description available to others. Made of ¾ inch lumber, its outside dimensions are 12×6½×6½ inches. The handle, which also serves to support the trigger mechanism, increases the overall width by 1 inch and makes the total height 9¼ inches. The door is made of two pieces of wood nailed together so as to comprise the front and two thirds of the top of the box. Two nails are passed through holes drilled in the sides of the box, and driven into the top of the door near the back edge to form a hinge. A cross piece just behind the door gives rigidity to the box in addition to that supplied by the handle, and furnishes a support for the edge of the galvanized hardware cloth (one-third inch mesh) covering the balance of the top as well as the back of the cage. This wire, the edges of which are covered with wood strips so as to protect the operator's hands, makes it possible to see what is in the trap, and also provides a base for the trigger, which consists of a 20d nail and a piece of wood ½×½×11 inches, the latter loosely wired to a staple driven into the front edge of the top of the door. A notch, one-sixteenth inch deep, is cut into the nail with a hacksaw 1½ inch from the head, and is filed to a taper on the upper side only. Since the nail head under which the lever supporting the door is placed, is slightly curved and the notch in the nail shallow, the mechanism releases at the slightest touch, but is not too sensitive to jarring. The bait, such as a piece of carrot or bread crust, is placed on the point of the nail. The possibility of hooking the nail to either side of any one of the squares of the wire mesh is of great convenience when the effect of the weight and varying center of gravity of the bait is considered.

Trapping on the mainland of Galveston County, Texas, has proved best in fields which have neither been plowed, burned nor pastured for several years. The labyrinthine runs can be located under the lodged dead grass of a previous year. Those in current use are easily recognized by the absence of green growth or debris in the center of the run. Traps are set to the side of the run with the door facing the run, a convenient location being where the run crosses a rabbit trail. In carefully chosen fields about one trap in five can be expected to yield a rat each night of trapping.

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DISCUSSION

THE SUPPORT OF EDUCATION IN A DEMOCRACY

IN an article in the June 22, 1945, issue of SCIENCE Dr. E. V. Cowdry points out that private institutions of higher learning are finding it increasingly difficult to survive because of financial difficulties engendered by a number of causes. Among these causes may be listed a diminution of donations, decrease of income from investments and dependency of private institutions upon students' fees.

Dr. Cowdry offers three reasons for the support of private institutions: their training of leaders in business, in the professions and in science and letters;

[2] W. Patten, *Arb. aus d. Zool. Instit. der Univ. Wien*, Bd. 6, 1885, pp. 149–174.

[1] The work which formed the basis of this paper has been supported in part by a grant from the John and Mary R. Markle Foundation for the study of filariasis.

their preservation of the freedom of higher education; and their stimulus to public-supported institutions, both in competition and in the exchange of personnel and ideals.

The suggested remedy is to give private universities and colleges the privilege of purchasing high-interest bearing bonds from the government on the basis of educational service rendered. The author summarizes his ideas in one succinct sentence: "It would simply be the right of *all private institutions of higher education listed in the U. S. Office of Education* to avail themselves of this federal aid *in proportion to the educational service they perform*" (italics mine).

Here Dr. Cowdry offers a means of determining who should receive aid and how much aid should be given. It seems necessary to clear up this point, because Mr. Harold R. Rafton, in the August 3, 1945, issue of SCIENCE, confuses the conditions of the aid with federal control.

Mr. Rafton lays down a number of restrictions to insure that the aid goes where it should go. The first two of these are good, in so far as they provide an objective means of evaluating the educational service rendered, by considering the teaching facilities and the number and abilities of the students of institutions.

These restrictions do not imply federal control in the sense that is undesirable, that is, that the government run the universities or lay down their policies or favor ideologies that are false.

The third restriction suggested by Mr. Rafton implies a misunderstanding of the services rendered by sectarian or religious schools. It reads "(3) the institution shall not be controlled by or affiliated with any religious sect or organization, shall not require any religious qualifications of any of its governing personnel or boards, or of its faculty, or of its student body, and shall not require attendance at any course in religious instruction, or at any religious services."

The fundamental objection of Mr. Rafton is that sectarian institutions do not provide a secular education but exist to perpetuate a religion. He says, "To the non-legal mind, at least, the granting of such a subsidy to sectarian institutions seems to contravene the spirit, if not indeed the letter, of the constitutional provision against the establishment of religion."

Actually what the establishment of religion means is the creation of a state religion, where the government decides what the national religion shall be, regulates the religion, and pays for the upkeep of churches, seminaries and the salaries of ministers. Wisely the writers of the first amendment provided a check against this, so that people of many faiths, or even no faith at all, can live together harmoniously. This was not meant to shackle religion but to prevent intolerance.

Religious institutions do not say that there is anything wrong with secular education in itself, but that it lacks something, namely, religious training. What the sectarian schools teach is not something other than secular education, but they teach the entire secular curriculum plus religious training. In other words, they provide all the educational services that non-sectarian institutions provide, and, in addition, to those who wish it they give religious training.

Surely, if the purpose of the plan is to foster private educational service, there is no good reason to discriminate between those curricula that include religious training and those that do not.

In short, the principal objection to Mr. Rafton's third restriction is that it judges institutions, not on the basis of educational service rendered but on the personal beliefs of the governing body and because of courses or training offered above and beyond the usual educational services. For example, it reads that "the institution shall not be controlled by or affiliated with any religious sect or organization." This discriminates against an *educational institution,* not on the basis of its teaching facilities nor of the abilities of its professors nor of the courses that it offers but solely on the basis of its creed. This is contrary both to the spirit and letter of democracy.

Following the same line of thought, one might add a fourth restriction, covering not the religious beliefs of the men who control the institution but their race or color. Such reasoning has been followed in totalitarian countries.

In the rest of the restriction the government tells the institution how it should be run, no matter how much or how good the educational service which it renders. This is the very essence of regimentation. As a matter of fact, most sectarian institutions more or less fulfil the rest of the restriction, with the obvious exception of not handing control of the sectarian institution into non-sectarian hands.

The objection—"what equity could be claimed for a scheme which would tax the greater part of our population without religious affiliation to provide support for religious institutions of the lesser part?"—misses the point; for the scheme asks support for educational service and not for religious institutions as such—churches and seminaries and missions.

This brings up a strong argument in favor of the scheme. All contribute in taxes for the support of public institutions of learning, but many attend private institutions, saving the government the expense of their education by not attending a public institution and thereby paying twice for education, once in taxes, again in fees and tuition. What equity can be

claimed for a scheme that taxes all the citizens for educational purposes but makes some of those citizens pay a second time for an education although those same citizens thereby save the government money?

If all the private institutions of learning were to close their doors to-morrow, it would cost the government tremendous sums of money to purchase or replace their buildings and laboratories and libraries and to pay their faculties, in order to provide facilities for the students who attend the private institutions. The private institutions, sectarian and nonsectarian, are rendering the same service as the public; they both operate for the common weal; the work and expense of the private institutions would have to be borne by the public institutions if the private did not exist. Yet only the public institutions are supported by the government, whereas the private institutions must support themselves, although the students of private institutions have already paid for education with taxes. Is this equity?

Dr. Cowdry has suggested a federal subsidy to aid private institutions of learning in their financial difficulties. Mr. Rafton has suggested some stipulations for the subsidy. However, since private institutions render educational services the same as public institutions render and which are just as much for the common weal, since public institutions would incur the work and expense of private institutions if the latter were to fail, since the students of private institutions have paid taxes for their education anyway, it is suggested that the government (federal, state or local as the occasion demands) defray the expenses of the private institutions in the same manner that it supports the public institutions. The criterion for government aid shall be the amount and quality of educational service provided. To safeguard against undemocratic discrimination among institutions, only educational service shall be considered and not the creed nor race nor color of the leaders of the institutions. To obviate government control, the government may investigate private institutions to see that the claimed educational services are performed but may not appoint the leaders nor direct operation of the institutions.

To sum up: In a democracy, private educational institutions, inasmuch as they perform the same service that public institutions do, promote the common good, save public institutions the work and expense of education already paid for in taxes, should be supported by the government, federal, state or local, according to circumstances, both as a matter of equity and practical policy, without regard to creed, race or color represented by the institutions.

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THE ORGANIZATION OF BIOLOGISTS

AMERICAN biologists who have been aware of the inefficient way in which the potential contributing power of biologists was utilized in our recent war effort have had forcefully called to their attention one of the serious consequences of lack of general organization. Even more impressive indications of the need of organization, since they concern not the past but the future, are such matters as (1) the immediate need of more intimate international relations of scientific societies to parallel international cooperation along other lines, and (2) the prospects of the availability for distribution shortly of large federal funds for the furtherance of scientific training and research. Biologists now constitute the only major scientific group lacking a strong unifying organization. Their present organization consists of dozens of small societies, each concerned with a highly restricted area of biology and acting independently of most of the others. They lack entirely any body that can speak and act authoritatively for biologists as a whole.

The following are a few of the more obvious needs of American biology which could be furthered by a general organization, listed roughly in their order of relative importance:

(1) A public relations office to give biology legitimate publicity.

(2) Representation of the interests of biology in governmental and intra- and international scientific relations.

(3) Reduction in cost of, and increase in efficiency of, biological publications.

(4) Encouragement of the maintenance of balance in research and training among the various biological fields.

(5) A clearing house for the effective placement of biologists.

(6) Machinery for closer cooperation between biology and industry.

(7) Administration of fellowships and scholarships.

In view of the several abortive attempts by small groups of biologists during the past thirty years to set up an organization which would be capable of performing such valuable functions, one hesitates to propose any specific plan for doing so. It does appear, however, that the following would be a reasonable series of steps to take:

(1) Enlist the interest and support of the current officers of the various existing biological societies.

(2) Call a meeting of society representatives at the earliest feasible date.

(3) Present to the latter group for discussion a tentative plan of organization after consultation with officials of the American Chemical Society and the American Institute of Physics.

(4) Adopt a specific plan.

(5) Determine ways and means of obtaining funds to guarantee the financing of the organization during its first three to five years. (It would be assumed that the organization would be self-supporting at the end of this time).

(6) Select and appoint a permanent executive secretary and establish a permanent office.

It would be assumed that this proposed organization would be one in which biologists would participate for the concrete benefits they would derive from it.

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A POSSIBLE EXPLANATION OF "FREEZING" BEHAVIOR IN RATS

CURRENT adherence to the doctrines of biologism in the study of animal behavior has tended to obscure interest in the beginning of socially determined action and to favor explanations based on hereditary or innate patterns of individual variation. Thus in maze studies with small animals where the organisms are housed in groups in one cage, differences in learning scores in the maze are seen as the product of heredity or of the specific conditions of diet and experimentation. Very rarely is mention made of social interaction in the group-housing situation, although it is well known that patterns of dominance, aggression, food-hoarding and sex play exist. Surely some correlation may be expected between behavior under experimental control and the social environment of the living cage.

The author had an opportunity to apply the implications of the foregoing to random observations made over a period of some years during which the behavior called "freezing" was studied incidentally. "Freezing" is a phenomenon found particularly in learning experiments with rats and guinea pigs. It refers to a state of immobility on the part of the organism when it is inserted into the learning apparatus. The subject simply sits at one point in the maze. Increase in motivation is rarely effective in causing cessation of "freezing," which may continue for many trials and is then apt to disappear suddenly. The difficulties in incorporating data from such animals into learning studies have led some authorities to recommend the elimination of the organisms and the data from consideration. Where any discussion is found of the phenomenon, it is usually ascribed to emotional disturbance or to "pure cussedness."

The data under discussion here were derived from two groups of animals, one living in groups of six rats to a cage, the other consisting of animals in isolated, single cages. Of the 124 rats in the first group eighteen manifested "freezing." Only two rats in the other group displayed the behavior. Sex, age and stock variations were ruled out as causal, as were differences in handling since all these factors were identical for both groups. The only major difference in the treatment of the two sets lay in the manner of their housing and its consequences. Systematic observation of the behavior of the group-housed rats led to a variety of data of which only part will be presented here as preliminary to a larger report. This note takes into account only that aspect of the inter-organismic relationship in which aggression of one or more animals against another is manifested. Social hierarchies such as those found among chicks and baboons are not well established in rats but fighting is common and there have been some observations of dominance and submissiveness under these circumstances. In our animals, of those which "froze" from the group-housed experiments, fifteen were definitely and rather consistently the submissive or aggressed against organisms. The remaining three were all dominants and winners in fighting. It would seem then that the phenomenon in question is the result of the hitherto uncontrolled factor of social interaction in the living quarters of the experimental animals.

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SCIENTIFIC BOOKS

VIRUS DISEASES

Virus as Organism. Evolutionary and Ecological Aspects of Some Human Virus Diseases. By FRANK MACFARLANE BURNET. 134 pp. Cambridge, Mass.: Harvard University Press. 1945. $2.00.

THIS book, which is an expansion of the Dunham Lectures given at the Harvard Medical School, presents a discussion of some virus diseases of man from a consistently biological viewpoint. The discussion is the best that has ever been presented of the broad evolutionary and ecological aspects of virus disease. The author, who is a distinguished investigator and director of the Walter and Eliza Hall Institute of Research in Pathology and Medicine in Melbourne, Australia, does not pretend to discuss representative virus diseases or to present a balanced picture of the causative agents. He restricts himself to the six virus diseases which have been under investigation in his laboratory and confines his central theme to a por-

yal of the primary biological attributes of viruses, mely reproduction, variation, survival and evolu-n. He believes that viruses are micro-organisms ich have evolved by parasitic degeneration from ger micro-organisms, that heritable variations in uses arise by a process of discontinuous mutation entially similar to gene mutation in higher forms d that the mass transformation of a strain as ob-rved in practice is the result of selective survival d overgrowth of one or more mutant types. It is ggested that, although important future develop-nts in the finer laboratory study of viruses can be oked forward to with certainty, the pragmatic neces-y will remain for regarding viruses as organisms—lf-reproducing, varying and surviving like other ing beings. Discussion of recent developments in dies on chemical and physical properties of viruses omitted, despite the fact that many of these, such studies on the chemical composition of viruses and virus strains, have a direct bearing on the basic oblems of virus multiplication and variation. No tempt is made to deal with the admittedly very diffi-lt task of reconciling the results of the physico-emical approach with the biological viewpoint opted by the author. However, this must not be garded as adverse criticism of the book, for the thor states at the outset, and constantly reminds readers thereafter that the discussion is presented om a consistently biological angle. It is recognized at such a discussion can only give an incomplete count of the facts that are now known about uses. The virtue of the book lies in the fact that e author writes only from the viewpoint with which is most familiar and only about those viruses and seases with which he has worked. As a result the ok is highly authoritative and very stimulating. o other book has succeeded in bringing into such cellent focus an over-all picture of virus diseases om the standpoint of evolution and ecology.

The first chapter contains a discussion of the re-roduction, variation and survival of viruses. The thor points out that every virus particle derives by netic descent from some similar particle and in turn ossesses the power to produce, under appropriate nditions, replicas of itself and that there is no evi-nce that any virus arises *de novo*. He believes that rotein production in general will eventually be un-rstood in terms of replica production by subcellular, sentially living entities. This statement provides e key to the different attitudes that have been opted by biologists and by chemists. In general, e biologist is content to view the over-all system a growing, metabolizing, living entity and to take fuge in the "living state." The chemist, on the her hand, is quite willing to devote time and energy to the unraveling of the multiplicity of chemical reactions that go to make up the "living state." He is ready to debate whether the structures that participate in the final reaction that results in the production of a protein molecule are, in fact, "living." However, it is likely that chemists and biologists are closer in their thinking than might appear on the surface and that the viruses may provide the ground for a common meeting place.

In the second and third chapters on "Evolution and Change in Virus Disease" and "The Reaction of the Host to Virus Infection" the author draws from his generous store of knowledge of disease and presents stimulating and interesting discussions. He considers how viruses might have originated and dwells on the widely accepted view that viruses represent the degenerate descendants of larger pathogenic micro-organisms. The work of Beadle on the mold, Neurospora, is described in this connection. There is a provocative discussion as to whether virus diseases of man have resulted from the transfer, to the human host, of viruses that have evolved as specific parasites of some other abundant species. Many aspects of the interaction of virus and host are presented and it is emphasized that for any given disease the three major factors responsible for variation in character with time and place are past experience of infection, the age distribution of the community affected and the virulence of the current strain or strains of the pathogen responsible.

The following chapters are devoted to the ecological and evolutionary aspects of six virus diseases of man. These include herpes simplex, poliomyelitis, psittacosis and related infections, smallpox and similar pox diseases, yellow fever and influenza. The chapter on poliomyelitis is especially well written. Throughout these six chapters, the virus, its mode of survival, its characteristic range of variation and its possible evolution provide the center of attention. The importance of the transfer of virus infection from one host to another and the fact that transfers from animal reservoirs to man are taking place at present are stressed. One of the major modern accomplishments, namely, the development and effective use of a yellow fever vaccine, is not mentioned in the chapter on yellow fever. However, the eventual removal of one species as a host for a virus may be regarded by the author as relatively unimportant in the broad picture which he presents. As a whole these six chapters, as well as the concluding and introductory chapters, are written in an authoritative and interesting manner. The discussion is presented from a consistently biological point of view, and for this reason this book should not be used to introduce the novice to viruses. However, the book contains a most excellent discussion of the broad evolutionary

and ecological aspects of virus disease and should therefore be read by all who are interested in viruses.

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HIDDEN HUNGER

Hidden Hunger. By ICIE G. MACY and HAROLD H. WILLIAMS. Lancaster, Pa.: The Jaques Cattell Press. 1945. $3.00.

THE title of this book denotes the malnutrition resulting from diets which may satisfy hunger in the usual sense, but which are lacking in one or more of the specific nutrients required for optimum health and performance. Against a historical background, the book records the contemporary developments which have led to our present knowledge of the causes of this hidden hunger, and of ways of eliminating it. The authors, life-long students and investigators in nutrition, are particularly well qualified to deal with the field covered. Without sacrifice of scientific accuracy, the discussion is presented in language that the general reader can understand and profit from accordingly. The scientist also will find the book a source of much valuable information which is well documented with references.

The first chapter traces the origins of nutrition science which grew out of man's primary need for food and of his early observations on the relation of diet to disease. It reveals how our present knowledge has developed through the application of data obtained by research in many different fields, such as chemistry, physiology, agriculture, medicine and home economics. In the following chapter, the nutrition activities of important national and international organizations and conferences, past and present, are reviewed.

The choice of foods and their utilization are next considered, particularly in connection with problems of food habits, food fads and abnormal appetites. A discussion of the various nutrition deficiency diseases which are responsible for poor health follows. Food production receives attention in a chapter devoted to the basic importance of the soil as a source of our food supply. The contributions of soil, plant and animal science in improving this supply are discussed. Economic problems of land utilization are reviewed.

A comprehensive chapter considers the chemistry, physiology and functions of the various chemical substances with which nutrition science deals—the energy-forming nutrients, the amino acids and the many minerals and vitamins of which a complete diet must be composed. Succeeding chapters translate these nutrients into foods and into use. First, there is a discussion of the problems of food supply and of the various services involved in getting food from the farm to the consumer. Food processing, preservation and cooking are here dealt with. A discussion of fortified foods, notably enriched flour and bread, is included. A chapter entitled "Food in Action" makes a comparison between the knowledge available during World War I and World War II, thus revealing the large advances in nutrition science. Another chapter is devoted to the accomplishments during World War II in improving the industrial workers' health. A discussion of the development of rations for our armed services follows. It reveals the contributions which have been made by the new knowledge of nutrition and by current experiments carried out to solve specific problems.

The final chapter is entitled "Food for Thought." It reviews recommendations set forth by the United Nations' Conference on Food and Agriculture as a background for a discussion of some of the problems which will arise in carrying them out. It closes with a review of some of the developments which should result in a healthier people in the future.

The foregoing summary indicates that the book has a much broader scope than is indicated by its title. Some readers may feel that an attempt has been made to cover too many topics and too many fields in a book of this size and purpose. Some of the topics are not very closely related to the title but their discussion does serve to show the many factors which must be taken into account in advancing the field of nutrition. The diversity of topics discussed and the many long quotations in fine print may, at times, tend to distract the reader from the main theme. But these are minor matters with respect to a book which contains a large amount of valuable scientific information in a very readable form.

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BOOKS RECEIVED

BOK, BART J. and PRISCILLA F. BOK. *The Milky Way*. Second Edition. Illustrated. Pp. vi + 224. The Blakiston Company. 1941.

DE MENT, JACK and H. C. DAKE. *Uranium and Atomic Power*. Illustrated. Pp. x + 343. Chemical Publishing Company, Inc. $4.00. 1945.

FITZGERALD, A. E. *Basic Electrical Engineering*. Illustrated. Pp. ix + 443. McGraw-Hill Book Company. $3.75. 1945.

FRAPRIE, FRANK R. and FRANKLIN I. JORDAN. *American Annual of Photography, 1946*. Illustrated. Pp. 20[illegible] American Photographic Publishing Company. Paper, $2.00; Cloth, $3.00. 1945.

GRINKER, ROY R. and JOHN P. SPIEGEL. *War Neuroses*. Pp. ix + 145. The Blakiston Company. $2.75. 194[illegible]

LIPSON, C. and W. M. MURRAY. *Experimental Stress Analysis*. Vol. III, No. 1. Illustrated. Pp. xviii + 154. Addison-Wesley Press, Inc. $5.00. 1945.